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TWENTY-TWO YEARS OLD.

With the present number, THE ELECTRICAL WORLD enters into its twenty-third year. As customary in our anniversary issues, we present this week a special budget of reading matter, the generation of electricity by water-power and the discovery of Röntgen furnishing in this instance the principal topics treated. Though for this purpose our space has been extended 50 per cent., yet several interesting contributions specially prepared for this issue have been crowded out, and will appear in succeeding numbers. Owing, also, to the pressure on our space, the important series of articles on "Central Station Working" is not represented in this issue, but it will be resumed in the next number.

MASSACHUSETTS CENTRAL STATIONS.

The report of the Massachusetts Board of Gas and Electric Light Commissioners for the year ending June 30, 1895, makes the usual showing in regard to the central electric lighting stations of that State; that is, prosperity on the part of the larger stations and the reverse for the smaller ones. Of the 84 stations supplying electricity, 24 form part of gas works. Of the entire number six did not earn expenses, and 33 others did not earn sufficient to warrant the declaration of any dividend. The purely electrical companies paid dividends aggregating $487,000, but of this amount the two Boston companies alone paid $300,000, and if the payments of companies in seven other large cities or towns are also subtracted, we find that the remaining 56 companies only declared $60,000 in dividends. The balance sheet shows that the aggregate dividends amounted to 5.1 per cent. on the capital stock. The operating expenses, including the gas central stations, were 36 per cent., the distributing expenses 14 per cent. and management and office expenses 8 per cent., respectively, of the income. During the year $565,000 were charged off for depreciation, or $411,000 more than the previous year. We note that the Edison Company, of Boston, and the Worcester Electric Light Company alone charged off more than the entire amount credited to all the companies of the State the previous year, and about 40 per cent. of the total was due to forced reduction in plant accounts by foreclosure sales. The commissioners state that official reports relative to action concerning the municipalization of gas and electric supply have thus far been received from 238 towns and cities. There are now 12 municipal plants in the State, two of which were put in operation during the year. Two of these plants supply both gas and electricity, and three purchase current from private companies in neighboring towns. The Commissioners request legislative action giving them powers with respect to requiring uniformity in the manufacturing records of the companies. Should these powers be granted it is hoped that publication of the data will also be permitted, for the information with respect to the division of operating expenses would be of interest to the entire electrical profession. Such publication would also be of value to those financially interested in central stations in the State, as it would furnish a means of comparison whereby they could determine, to some extent at least, the efficiency of their management.

POSSIBLE FUTURE DEVELOPMENTS IN ELECTRICITY.

Several articles in this issue deal with the possibilities that electricity may have in store for the future, the views expressed representing both the practical and scientific standpoints. Mr. Townsend Wolcott confines himself to the subject of the conditions governing electrical progress, and arrives at the conclusion that while really great and startling discoveries come unheralded, many advances may be predicted from a consideration of probable future conditions

favoring development. This is well illustrated by the history of arc and incandescent lighting and of the dynamo. It would have required little imagination half a century ago to have foreseen the present wide application of electric lighting if a cheap source of current had been assumed. On the other hand, if the possibilities of electric lighting had been foreseen by Faraday, the principles of the commercial dynamo would probably have been established in his own day. Electric lighting awaited a cheap source of current, which latter in turn awaited electric lighting, and not until commercial consideration became ripe were both realized, though easily predicable. It is the grander discoveries, like that of induction, telephony and the recent one of Röntgen, that come without announcement, if we except prophecies and speculations having no justification in existing knowledge, but are rather of the character of flights of disordered fancy which only hit the mark by accident. Prof. Fessenden is more specific in his indications, and in electrical engineering points out a number of cases which undoubtedly merely await favorable commercial conditions, the electrical problems involved having already been solved. The great awakening of interest in molecular and etheric physics brought about by Prof. Röntgen's recent discovery will cause those subjects to be vigorously attacked, and gives reason for the prediction that we are near to a knowledge of the true nature of electricity, gravity, heat, light and chemical action, which thus far have defied experimental research and remained matters of hypothesis. We fear that but few of our readers will agree with Prof. Fessenden that the assumption by municipalities of transportation and electric lighting will put an end to municipal corruption. The greater opportunities for stealing would rather have a tendency to attract rascals of higher ability, and to so perfect the mechanism of corruption that the citizens would be even more powerless than at present. With even the United States Senate openly accused as being subject to corrupt influences, there seems to be little hope of attaining general virtue in municipal government, at least under present political conditions.

WATER-POWER ELECTRICAL PLANTS.

In this issue we print an extensive article on the subject of water-power electrical plants, which contains much that will be of interest to the general electrical reader as well as to the engineer. The list given in the article of such plants now installed in the United States, is a fairly complete one, but a supplementary list will be printed later making a number of additions, the data to accompany which are now being collected. A number of typical plants have been chosen for illustration, ranging from the Sacramento-Folsom power transmission—the first in the world to transmit a large amount of power a considerable distance—to a small town lighting plant. The great compactness of water-power plants is rendered strikingly apparent from the plans of arrangement shown, and in ease of operation they are, of course, infinitely superior to steam plants, scarcely any attention being required. The utilization of water-power for electrical generation is unfortunately dependent upon two circumstances to which frequently the necessary weight is not given—the cost of development and the variation of flow throughout the year. The former is more usually neglected by popular writers, who grow enthusiastic over the generation of electricity at no cost for coal, with no expensive steam machinery subject to costly repairs and with little cost for attendance. The other matter, however, is sometimes not sufficiently considered even by engineers. The amount of careful study that may profitably be put on the question of water supply was illustrated in an admirable paper read last year by the late Franklin Pope, before the Niagara meeting of the American Institute of Electrical Engineers, in which a method is outlined that was pursued by him in connection with a water-power proposed for use for electrical generating purposes. Another disadvantage formerly urged against water-power machinery—that it does not admit of close regulation—is happily becoming of less and less weight through the introduction of efficient governors. How efficient such governors may be made is illustrated by the tests mentioned in the note on the Sacramento plant, where there was but a variation of 3 per cent. when the entire load was suddenly thrown off, and less than 2 per cent. when 25 per cent. of the load was suddenly removed. Many water-power manufacturing plants not running at night might add to their income by installing electrical generating machinery for operation during the night hours in connection with storage batteries, and to take up any excess of power during the daytime. Now that perfectly reliable batteries are made for storage on a large scale, and subject to a depreciation not any greater than that of steam boilers, many mills should find it a profitable investment to sell electrical power to local lighting companies, or directly to consumers. The California transmission plants and the Buffalo-Niagara transmission will before long furnish exact data on the commercial aspect of transmitting electrical power to a distance, and also result in definitely settling questions of design and method of operation. We may then expect to see a great extension in this field, though it does not appear probable in any event that power will be transmitted to the great distances formerly thought commercially practicable.

Meeting of the American Institute of Electrical Engineers.

The February meeting of the American Institute of Electrical Engineers was held at 12 West Thirty-first Street on the evening of Feb. 26.

Before proceeding to the regular business of the evening, a vote was taken on the question of incorporating the Institute. The result was, 39 yeas and no nays.

The regular business of the evening was the discussion of Mr. Frank J. Sprague's paper on electric elevators, which was read at the January meeting. The discussion was opened by Dr. Cary T. Hutchinson, who gave the results of a test, made by himself, of the six elevators in the Postal Telegraph Building. Mr. George Hill then discussed the subject for more than an hour. The other participants in the discussion were Messrs. Franklin S. Holmes, H. Ward Leonard, R. P. Bolton and John D. Ihlder.

The discussion was very animated and interesting, and some important facts were brought to light, but several points in controversy were nevertheless left unsettled.

Telephone Exchanges as Common Carriers.

The Norwalk (O.) Telephone Company has filed a petition to compel the opening of the lines of the Central Union Telephone Company, by mandamus if necessary, to the use of the local company, under the provisions of common carrier law, which, it is claimed, governs telegraph and other companies. The Norwalk Telephone Company is the pioneer in this move and believes it will carry its point. Hon. C. H. Gallup is the president of the company, and its attorneys are Hon. C. P. and L. W. Wickham.

Röntgen Rays.

In a letter to the *English Mechanic*, Mr. C. J. B. Findon quotes the following from a work by Prof. Hitchcock, of Amherst College, entitled "The Religion of Geology," and published in 1851:

"We might expect them (chemical rays) to operate in the dark, and experiment proves that they do. An iodized silver plate was placed on one side of an engraving on paper, and an amalgamated copper plate on the other side, and left in the dark 15 hours. On exposing the amalgamated plate to the vapor of mercury, a very nice impression of the engraving was brought out, it having been effected through the thickness of the paper.—(Mr. Hunt, 'On the Changes Which Bodies Are Capable of Undergoing in Darkness.'—*Phil. Mag.*, Vol. XXII. p. 277.)"

Acetylene Gas.

A petition was introduced in the Massachusetts Legislature on Feb. 14 praying that the manufacture and sale of acetylene gas be prohibited on the ground that it is dangerous to life and property. It is also asked that the storing of the chemicals from which it is manufactured be forbidden. A committee of the Legislature is suggested to investigate and report on the matter.

Brooklyn Traction System Leased.

The consummation was announced last week of the lease by the Nassau Electric Railway Company, Brooklyn, of the Brooklyn Traction system, negotiations for which have been pending since last November. By the terms of this lease an annual rental of $150,000 is guaranteed the Brooklyn Traction Company for the first two years and $180,000 thereafter.

The Nassau road agrees to spend within a year $500,000 for betterments and assumes the fixed charges of the Brooklyn Traction system. If any default is made in the fixed charges, the property is to revert with its betterments to the present holders. The present capitalization of $6,000,000 common and $3,000,000 preferred is to be converted into $4,500,000 4 per cent. guaranteed stock. The common stockholders will receive one share of new for four shares of old if they choose to subscribe for 7½ per cent. of the amount of their stock in Brooklyn, Bath & West End bonds at par, otherwise their stock will be reduced 40 per cent.

The Brooklyn, Bath & West End bonds are to be jointly guaranteed by the Atlantic Avenue Railroad Company and the Nassau Electric Company. Of the $1,000,000 of these bonds now in the treasury of the Atlantic Avenue Company $550,000 will be reserved to retire existing bonds as they mature.

The National Electrical Exposition.

The public will have an opportunity to witness the new method of photographing through solids at the electrical exposition to be held in New York City in May in connection with the nineteenth convention of the National Electric Light Association. Mr. Edison has succeeded in making a picture through eight inches of yellow pine, and anticipates no trouble whatever in making instantaneous radiographs. He has generously offered to send to the exposition his most powerful and improved apparatus for making radiographs, and his own corps of laboratory assistants to operate the same. Mr. Edison will also send to the exposition his large collection of experimental apparatus and designs pertaining to his early work on his many inventions, much of which has never yet been shown to the public.

The National Electric Light Association Convention.

The Trunk Line Association has granted a rate of a fare and one third for the round trip from points in their territory, to delegates attending the nineteenth convention of the National Electric Light Association, to be held in New York City May 5, 6 and 7, 1896. The convention will be held in a hall most admirably adapted for the purpose, that of the Industrial Building, Forty-third Street and Lexington Avenue, during the progress of the National Electrical Exposition.

Photographing Through Opaque Bodies.

BY N. H. DANIELS, JR.

In your issues of Feb. 15 and 22 you have mentioned certain experiments showing that by the aid of the sunlight, photographs can be made through opaque bodies, if a long exposure be given. As no explanation of the results is given, I conclude that Mr. Freedman and Dr. Lefferman suppose them due to Röntgen rays in sunlight. An experiment which I made on Feb. 17 would seem to disprove this idea, and to show that the action is due to the small amount of light which filters through the vulcanite slide during the long exposure.

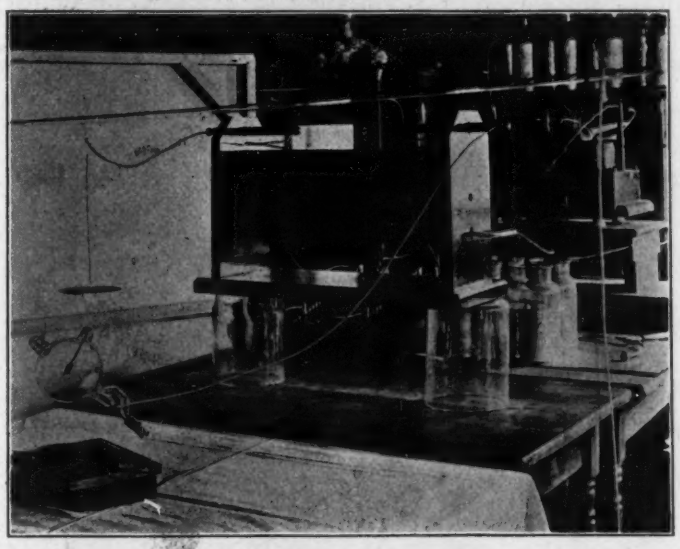
I placed pieces of iron, lead, aluminum and glass on the vulcanite slide of a plate holder containing a sensitive plate, holding the iron and aluminum in place by pasting them to strips of thin yellow paper. Above the slide I placed a small lens, so that it concentrated the light without bringing it to a focus. The plate was exposed for two hours to strong sunlight and developed.

Those parts of the plate which had been under the metal *or paper* were comparatively unaffected, while the rest of the plate became dark. That part of the plate on which the rays from the lens fell became very black. Only the outline of the glass on the slide could be seen.

Experiments have shown that Röntgen rays are not refracted by glass, and that glass is quite opaque to them, hence this experiment seems conclusive that it is sunlight and not Röntgen rays which act on the plate through the slide. It is of interest to note that a piece of thin yellow paper cast as heavy shadow as an iron washer 1-16th of an inch thick.

Röntgen Radiographs.

We print herewith two engraving of radiographs made by Mr. Herbert B. Shallenberger in the laboratory of O. B. Shallenberger at Rochester, Pa., which, however, have suffered severely in the untrustworthy and inefficient half-tone process of reproduction. The original prints are strikingly distinct. The flesh shows but in



SHALLENBERGER APPARATUS.

faint shadow, while the bones and joints are delicately shaded, having the appearance of actual photographs taken by reflected light, almost all of which is lost in the reproduction. This shading effect is due to the greater thickness of bone each side of the central portion, which again becomes lighter near the edge. Even thicker por-

RADIOGRAPH OF PORTION OF RAT.

tions of flesh are indicated by delicate shading, and in the radiograph of the rat, ligaments can thus be readily traced.

The experiments of Mr. Shallenberger with Röntgen rays have proven unusually successful, and although he claims nothing in the way of invention relating to these investigations, the manipulation

of his apparatus and the method of utilizing the current are somewhat in advance of anything which has yet come to our notice. The apparatus used is of the high-tension, oscillating type, which has been used for the illumination of vacuum tubes and other so-called Tesla experiments. This current seems peculiarly adapted to this special work, and results have been obtained with Mr. Shallenberger's apparatus (shown in an accompanying illustration) in one fourth of the time consumed by other experimenters.

Radiograph of Hand and Wrist. (From Two Prints.)

Current is taken from an ordinary alternating-current dynamo of a frequency of 133 periods per second, and is applied to the primary coil of a transformer, increasing from 100 volts to from 16,000 to 25,000 volts. This current is then led through Leyden jars and a double cascade of slightly separated brass cylinders, whereby it is changed into a current of an extremely high frequency. This oscillating current is then passed into a primary coil of an induction coil, having very few turns of wire and no iron core, and having a ratio of 7 to 1. Here the current is increased to from 160,000 volts to 250,000 volts. It is this current that is used with the bulb to produce the Röntgen rays.

The current as it comes from the 25,000-volt transformer and before it reaches the induction coil is, of course, of a very dangerous character, but as shown in Tesla's experiments, after coming from the induction coil, with an enormous frequency, it may be used without any fear of personal injury. So harmless is the nature of this current than an ordinary incandescent lamp may be lighted to full candle-power by passing the current first through the body.

The vacuum chamber is an ordinary Crookes tube; the objects to be photographed are placed on a plate holder slide, and about 4½ to 6 inches from the tube. One peculiar feature in Mr. Shallenberger's experiments is that but a single wire is used to convey the current to the tube, which has the very great advantage of causing no heat whatever to be generated in the tube. As a consequence, there is no danger of breakage, and the same Crookes tube has been used in all of Mr. Shallenberger's experiments.

The large engraving is made from two radiographs so joined that the knuckle joints of the lower print coincided with those of the upper one, as the thumb did not have the same position in both prints they do not accord in this respect. The reproduction is full-size, but, as remarked before, the relation between the shades has been destroyed in engraving, and the sharp outlines have been lost. The exposure of the lower portion was 33 minutes and of the upper 21 minutes. The exposure of the radiograph of a portion of the body of a rat was 22 minutes.

In the investigation carried on by Mr. Shallenberger it has been found that almost equally good results may be obtained with either pole connected to the tube. The rays emanate from a central point, and will cast a distinct shadow of the so-called cathode plate when the photographic plate is placed slightly out of the field, but this effect is produced independent of polarity. So far as the present investigations have proceeded, the results obtained with the oscillating apparatus have been very satisfactory, and it is believed that in a very short time the length of exposure will be very much lessened.

At the Harvard Hospital some successful radiographs have been taken with Prof. Woodward's ray lamp, described in our issue of last week. One was of a normal hand, in which the bones were very clearly brought out, and another was of a hand with a deformity, which was very clearly indicated. With a voltage of 30,000 a radiograph was taken in five seconds.

Water-Power Electric Plants in the United States.

BY BUSHROD C. WASHINGTON, JR.

FOR ages man has sought to overcome the vast powers of nature and so control them that they do his bidding. Human genius has gained this contest, and on the eve of the twentieth century an enlightened world gazes in wonder and admiration while Americans harness the power of their greatest rivers, convert this power into electricity and transmit it many miles to manufacturing centres.

The first application of water as a power for driving mechanical devices is supposed to have been attempted in Rome, about the time of Augustus, and during the succeeding centuries various machines have been originated for the utilization of water-power, and recent years have witnessed most rapid and wonderful progress in their development. The old water-wheels of various types gave way to turbine wheels for ordinary heads of water, and to wheels of the Pelton type for extraordinary heads. The users of water-wheels are too familiar with these two types of wheels just mentioned for me to attempt to describe them here.

The first transmission of electrical power for industrial purposes was accomplished in the year 1878, at Sermaize, not very far distant from Paris, France. The dynamos in this instance were driven by steam engines. The application of water-power for driving dynamos followed shortly after this demonstration of the practicability of the transmission of power by electricity.

Engineers bent their energies toward the development of the best machines for obtaining the largest percentage of the power at hand, and transmitting it with the smallest loss and at a reasonable cost. The result of their deep thoughts and long, tedious and costly experiments is the utilization of thousands of horse-power that had been wasted daily, and the building up of great manufacturing centres. There are to-day at least 300 places in the United States where water-power is used for driving dynamos, and the resulting electrical energy used for light and power.

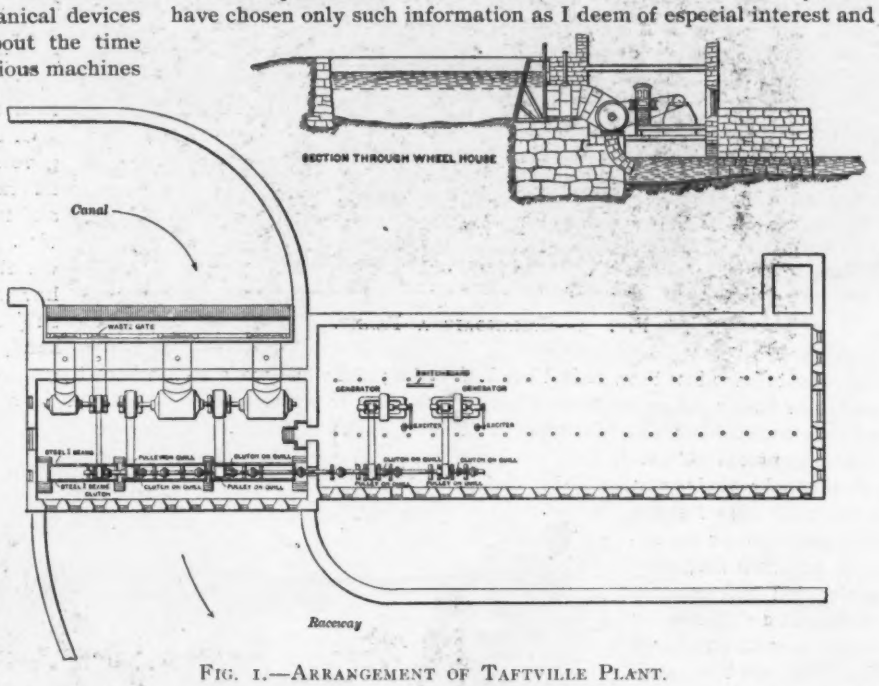


FIG. 1.—ARRANGEMENT OF TAFTVILLE PLANT.

By corresponding with the manufacturers of water-wheels and electrical machinery a fairly complete list of the places in the United States where water-wheels are used for driving dynamos has been obtained, and to the electricians of these electric plants a letter was written asking them to answer certain questions embodied in a circular enclosed with the letter. They responded quite promptly, and the result is, the following questions regarding their plants have been satisfactorily answered, viz.: The types of turbines; sizes of wheels; head and fall of water; horse-power of each size wheel under this head; whether wheels are operated individually or geared together; type of governor on water-wheel; types of dynamos—arc, incandescent or railway; dynamos driven from common shaft or independently; number arc and incandescent lamps; capacity, voltage and amperes of incandescent and railway generators; Is there any steam plant? Are the steam and water plants coupled electrically or mechanically? Is the water-power reliable the year round? Are storage batteries in use, and how? Number of miles of electric road operated.

It is not possible to tabulate this information in its entirety, so I have chosen only such information as I deem of especial interest and more readily tabulated. I have about 150 of my circulars returned properly filled out, and I have selected 124 of these for tabulation and as a basis for discussion. Where the first request for information was not answered I usually sent a second; this frequently met the fate of the first. A few declined to answer certain questions, but the majority cheerfully filled out the blanks and returned them to me; in many cases they added much useful information. The accompanying tabulated statement gives the location of the plants and information concerning their methods of obtaining power and converting it into electric energy, etc.

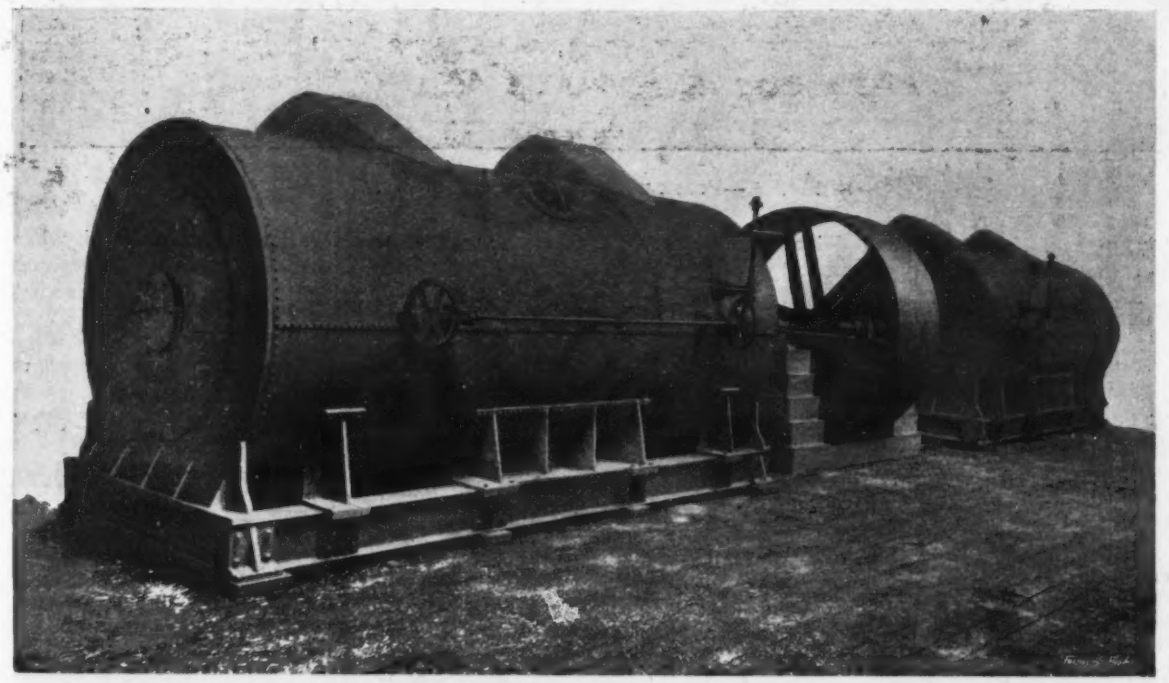


FIG. 2.—TURBINES OF WOONSOCKET PLANT.

Referring to the tabular statement, it is observed that nearly 40 per cent. of the water-power electric plants are situated in the New England States. This is accounted for in several ways: The presence of water-power and absence of coal in their geological structure, the thickly-settled condition of these States, and the innate, inventive genius and business principles of the people. Then, too, their proximity to the educational and business centres of the country is an important factor not to be overlooked. Over 65 per cent. of all

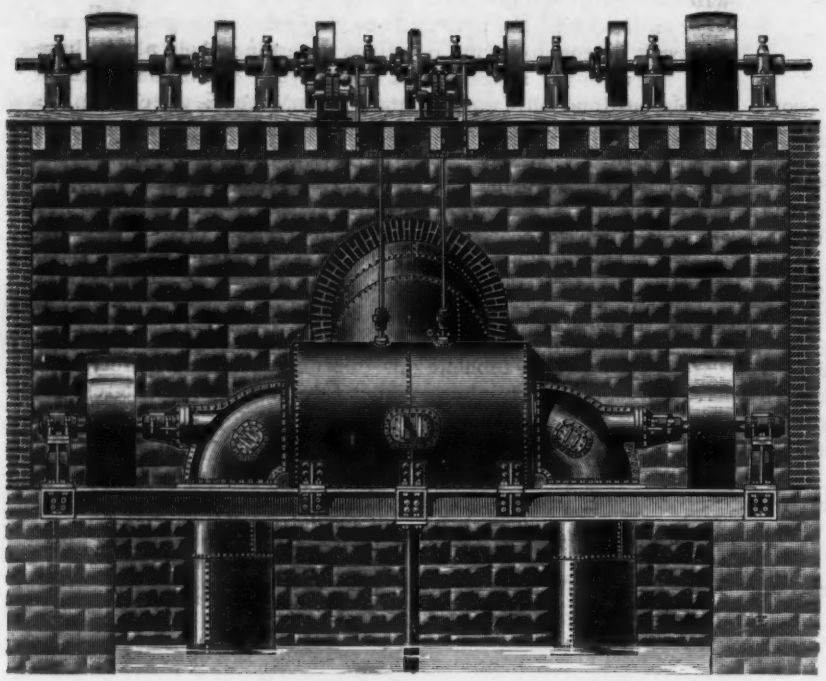


Fig. 3.—Canandaigua Plant.

these plants have less than 20 feet head of water; and when we consider how many places there are having this fall or greater, it is certainly astonishing that this power is allowed to run to waste. A great many mills and factories supply their own light, and also furnish light and power to villages in which they may be situated, and even to villages at a distance.

Only a small number of plants operate the water-wheels individually, and the majority of this small number have the wheels so arranged that they can be geared together. A favorite way of developing power is by using horizontal turbines arranged in pairs. In many cases where horizontal turbines and Pelton wheels are used, the water-wheel and armature of the dynamos are on the same shaft. About 70 per cent. of the dynamos driven by water-wheels are driven from a common shaft, clearly demonstrating that this is the better method of utilizing the power.

A little more than half of these plants have additional steam power. There are several reasons for this. First, the water-power is not sufficient to fully meet the requirements; second, the water-power is not reliable all the year round; and third, as a duplicate system in case of accident. The fact that many plants have additional steam-power, and have not stated what proportion of the work is accomplished by water and steam power respectively, makes it rather a difficult problem to fix the amount of work chargeable to water-power alone. The reader can solve a great deal of this problem by noting the work done by the plants using no additional steam-power. He will find that over 3000 arc and 100,000 incandescent lamps and 82 miles of electric railway are operated by the water-power plants alone.

The question of coupling water-power and steam plants is shown by the last two columns of the table herewith, to be overwhelmingly in favor of mechanical methods as opposed to electrical.

Of the 124 plants under discussion, 56 use water-wheel governors and 68 do not. Of the 26 plants operating electric railways, 19 use a water-wheel governor, five do not, and two have not stated whether or not they use such a device. The fact that so many plants do not use a water-wheel governor is almost conclusive evidence that they have a very steady power, and that the dynamos are not subjected to rapid fluctuations in their load. On the other hand, where exactly opposite conditions exist, as in cases where the power is used for street railways, a quick and reliable governor is a necessity, especially where the railway has many grades, and several cars are likely to ascend a grade at the same time.

Fig. 4.—Turbine of Sacramento Plant.

The utilization of water-power for developing electricity has become a great industry in this and other countries, and the leading manufacturers of water-wheels and electrical machinery are devoting

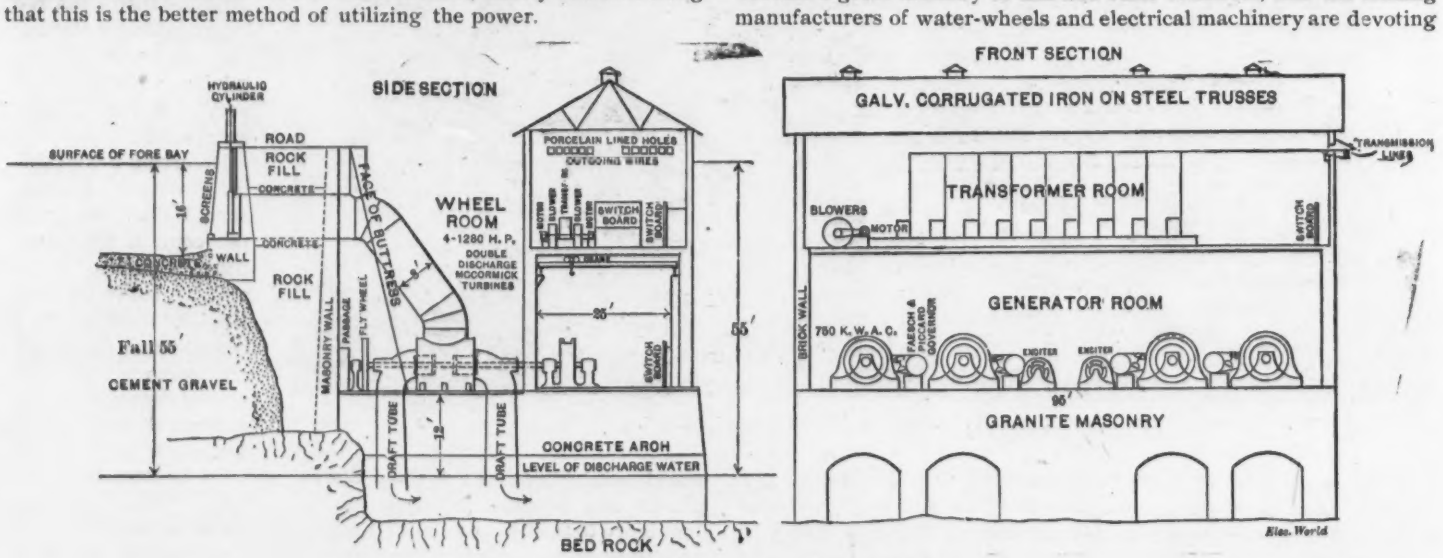


Fig. 5.—Arrangement of Sacramento Plant.

a great deal of their time and energy to the development of special machinery for this particular field.

There are a large number of very large electric plants operated by water-power, and these have been fully described in the catalogues of the manufacturers who designed and built the water-wheels and dynamos used in their construction and equipment, and also in the columns of many of the best technical journals.

The installation so successfully carried out at Virginia City, Nev., however, is worthy of especial mention. A dynamo cham-

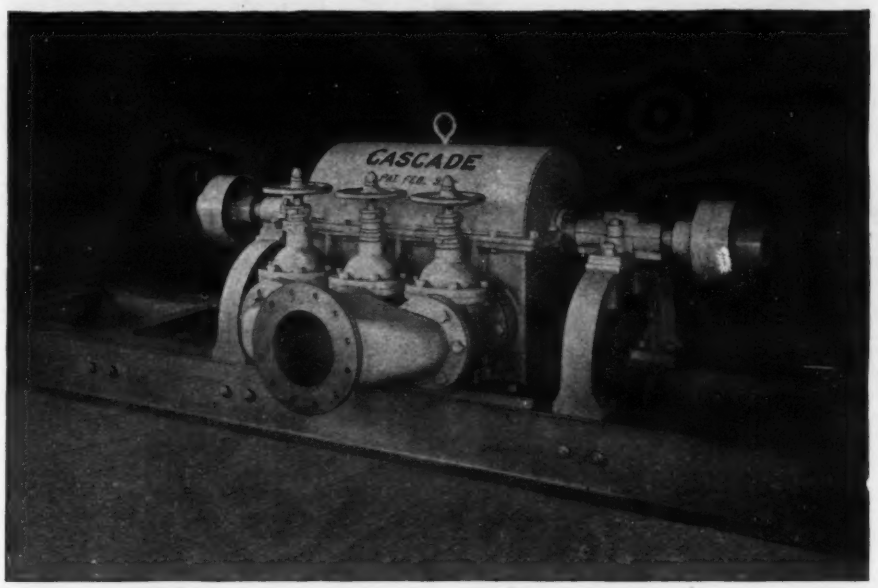


FIG. 6.—IMPULSE WHEEL, ANACONDA PLANT.

ber, 50 feet long, 25 feet wide and 12 feet high, was excavated out of solid porphyry at the 1650 foot level of the Chollar Mine. The water is brought down the shaft in wrought-iron pipes, these are united at the bottom into one single pipe, from which six six-inch pipes run to the nozzles of the water-wheels provided to drive the large dynamos. Under 1680 feet head 800 horse power is developed.

The use of water for generating electricity has almost revolutionized the important industry of mining. Where no large streams are available, small streams are piped together and carried down the mountain until a great head is obtained; here the electric power plant is located and the power transmitted by electricity to the mine and used for lighting it, and driving the stamp mills and hoisting machinery. In places where the location of the water-power is unsuitable for a manufacturing site, the power is developed at the falls and transmitted to the point where it is required.

The large manufacturers of water-wheels and electrical machinery are always willing to aid in the development of water-power by cheerfully answering questions relating to the subject, and, if need be, will send on skilled engineers to examine carefully the location of the water-power and make a full report upon the result of their findings.

There is a very complete report on the water-power of the United States in the Tenth Census Report. It shows that there are hundreds of places where there is a good water-power. These can be developed easily and made to pay a handsome dividend on the cost of development.

Fig. 1 is a sectional view of the water-power electric generating plant installed at Taftville, Conn. The General Electric three-phase system is here used, and the power transmitted from Baltic to Taftville, a distance of four and one-half miles. Three turbines, supplied by the P. C. Holmes Company, Gardiner, Me., work under a head of 22 feet; two of the turbines develop 800 horse-power each at 157 revolutions, and the third 300 horse-power at 244 revolutions per minute. The belts pass obliquely upward to the pulleys on the line shaft, and the turbines are kept at speed by Schenck electric governors. In the dynamo room are two 250-kilowatt General Electric three-phase generators, delivering current to the line at 2500 volts and running at 600 revolutions per minute. Part of the electric power thus generated is used to operate at Taftville, one of the largest cotton mills in this country, the remaining power being used by the Norwich, Conn., street railway.

A plant having somewhat similar functions to the above is now being installed by the Bridge Mill Power Company, at Pawtucket, R. I. This will be of about 1500 horse-power, and will generate current for operating a street railway, for electric lighting and for power purposes. There are five pairs of McCormick 33-inch wheels, made by the Rodney Hunt Machine Company, of Orange, Mass.; these will be set 10 wheels together, in steel cylinder cases, 10 feet in diameter.

The water right is the last on the Blackstone River. The fall is about 24 feet. After the river passes the dam it becomes almost immediately navigable. The power station is built upon a solid rock foundation, which has been blasted out for the purpose. The situation is exactly opposite the Goff Braid Mills on the right-hand side of the river. The water enters a large brick tube and from that separates into the various penstocks for the turbines. A 500-volt direct current will probably be used.

In Fig. 2 are shown two pairs of Victor turbines installed in an auxiliary generating station of the Woonsocket, R. I., Electric Machine & Power Company. The current from this station is partly used by an electric railway, and partly for power purposes at the main station. The turbines, which were built by the Stilwell-Bierce & Smith-Vaile Company, Dayton, O., are operated under a working head of 17 feet, and develop 600 horse-power. Midway between the two turbines will be seen the main driving pulley, which is 11 feet in diameter. The speed of the turbine shaft is 133 revolutions per minute. On the floor above the wheels is a heavy line of six-inch shafting, with a receiving pulley of 51½ inches face and 64 inches in diameter, connected by a three-ply belt 50 inches in width with the wheel shaft. The power generators are connected by 15-inch three-ply belts to three driving pulleys, each 69 inches in diameter and having a face of 15½ inches. Belt power is also transmitted from the same receiving shaft for manufacturing purposes. This plant is a good illustration of the flexibility of electric power, that part of the power of the turbines not used in the mill in which they are installed being used for electric railway purposes, and, during the night, the excess of current transmitted to a main generating station to drive electric dynamos.

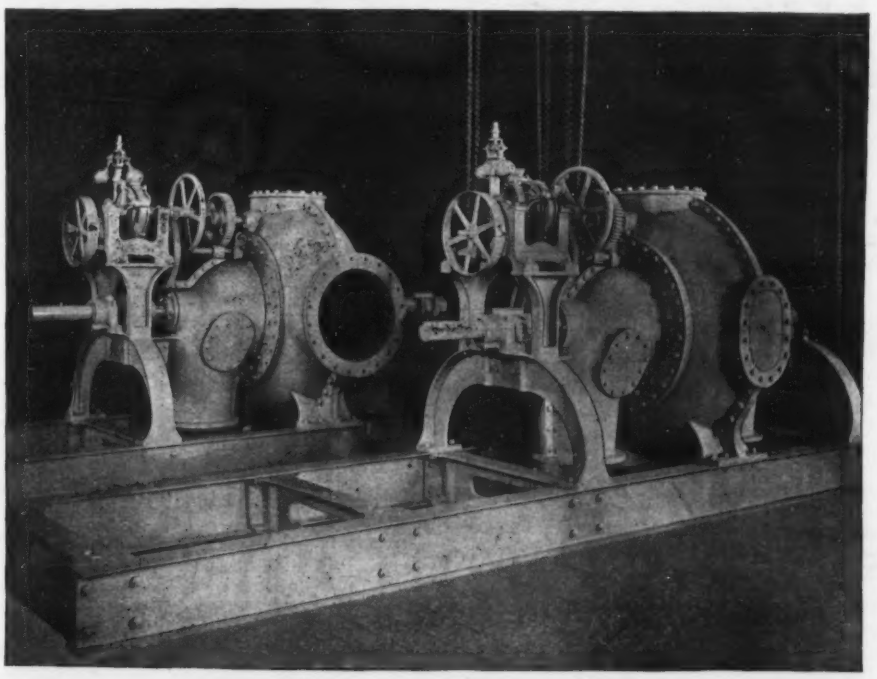


FIG. 7.—TURBINES, ANACONDA PLANT.

In Fig. 3 is shown the arrangement of the water-power plant of the Canandaigua, N. Y., Electric Light & Power Company, which illustrates the compactness that can be secured in such installations. The

wheels, which are of the McCormick type, and made by the S. Morgan-Smith Company, run under a head of 18 feet. The water-power is situated seven miles from Canandaigua, to which place the current is transmitted, and used for lighting and to run an electric railway.

Figs. 4 and 5 show the arrangement and one pair of turbines of the plant of the Sacramento, (Cal.), Electric Power & Light Company. There are four pairs of McCormick horizontal shaft turbine wheels supplied by the S. Morgan-Smith Company, of York, Pa., and located at Folsom. The governors are of the Faesch-Piccard type, supplemented by heavy fly-wheels on the turbine shaft. Each pair of wheels has a capacity of 1260 horse-power at 300 revolutions per minute, and are operated under a head of 55 feet. The plant also includes two special horizontal wheels for the exciters. The generators are four in number, of the General Electric three-phase alternating-current type, and furnish current at 800 volts potential. The armature shafts are direct connected to the wheel shafts by means of flexible couplings. Each generator is of 1000 horse-power, and all are located on the first floor of the building, 16 feet above the water in the tail race. In the second story of the power-house and directly over the dynamo room are sub-station step-up transformers, in which the E. M. F. is raised to 11,000 volts for transmission from the Folsom plant to the Sacramento transformer sub-station, a distance of 22 miles. At the sub-station the voltage will be stepped down to 125, 250, 500, 1000 and 2000 volts, respectively, for lighting and motor circuits. In this station are three 300-hp three-phase synchronous motors directly connected to a line shaft and driving 500-volt continuous-current railway generators and a number of arc machines.

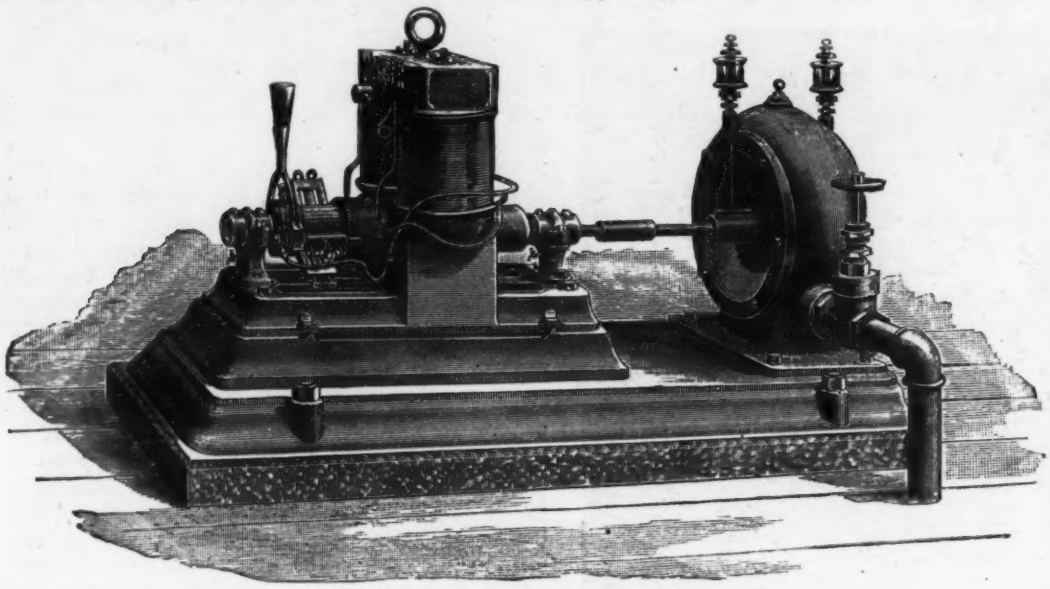


Fig. 8.—Direct-Connected Pelton Wheel.

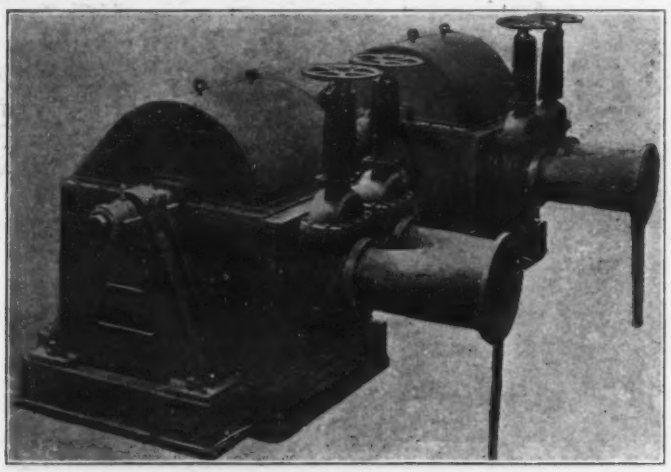


Fig. 9.—Wheels of Nevada County (Cal.) Plant.

At a recent test of these wheels, when a load of 800 horse-power was suddenly thrown off each pair, the governor regulated the speed of the wheels to within 3 per cent. of normal. When 25 per cent. of the load was thrown off suddenly, the governor regulated within 1¼ per cent. At present between 4000 and 5000 horse-power are being transmitted. The plant has been running steadily night and day since August of last year, and has proven most profitable and satisfactory in operation. All of the street-car lines of Sacramento are now run by electric power furnished by this plant.

Figs. 6 and 7 illustrate the turbines now being installed at Anaconda, Mont. Four wheels were furnished for this plant by James Leffel & Co., Springfield, O., to run under a head of water of 140 feet. Fig. 7 shows two of the power turbines, which are made to develop 250 hp at a speed of 600 revolutions per minute. One end of each turbine shaft is direct connected to a two-phase Westinghouse generator. Another of the turbines is also of 250 horse-power, but with a speed of 490 revolutions, and direct connected to a Brush arc light machine. A fourth turbine is of 50 horse-power at a speed of 820 revolutions per minute, and direct connected to a T.-H. dynamo used for power in combination with a special arrangement of storage batteries. The triple horizontal cascade or impulse wheel shown in Fig. 6 develops 20 horse-power under a working head of 125 feet, the speed being 775 revolutions per minute. Each end of the shaft is direct-connected to Westinghouse exciters, the latter being mounted on the same steel beams which carry the wheels, as in the case of the other generators.

Fig. 8 shows a Pelton motor connected direct to the shaft of a dynamo with an insulated coupling, both wheel and dynamo being mounted on a cast-iron bed plate. This form of water motor is particularly adopted for very high heads. The motor consists merely of buckets attached to the rim of a wheel; the water is discharged into the buckets from one or more nozzles, the impulse thus imparted revolving the wheel at a rate depending upon the head. With high heads such motors can be direct-connected to the dynamo, as in the case illustrated.

Fig. 9 illustrates one of two pairs of Pelton wheels made for the Nevada County (Cal.) power station. The power here generated is to be transmitted to the various mines in the vicinity of Grass Valley and Nevada City, located within a radius of seven miles, and is intended for operating mills, hoists, pumps, etc. It is also intended to run a railway between towns above named. The plant

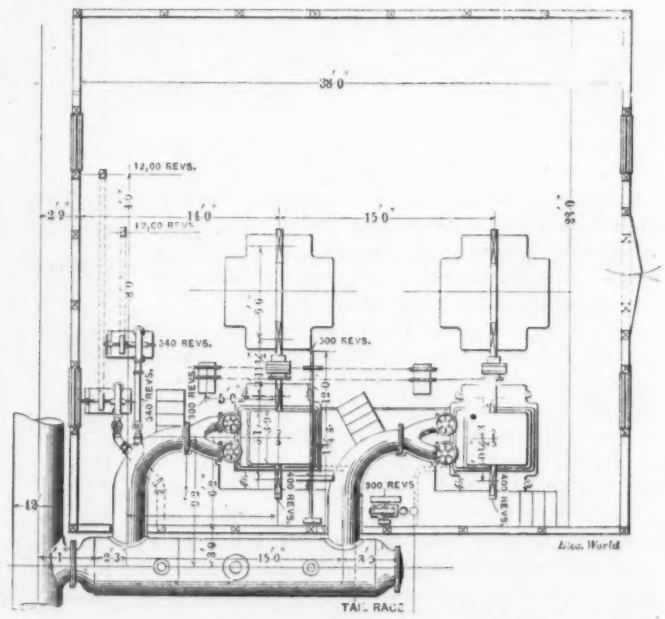


Fig. 10.—Arrangement of Nevada County (Cal.) Plant.

is located on the South Yuba River, the flume having been arranged to carry sufficient water to increase the plant to 2500 horse-power. The wheels are of 500-hp capacity each, and are run under a head of 206 feet at 400 revolutions. They are direct connected to two Stanley alternating-current generators of the same capacity. Two separate wheels are provided for the exciters, and Pelton differential

governors afford the necessary regulation. Fig. 10 illustrates the arrangement of the plant.

In Fig. 11 is illustrated the disposition of the turbines of the Ithaca Street Railway Company, Ithaca, N. Y. There are two 30-inch horizontal wheels, made by the Dayton Globe Iron Works, of Dayton, O., which operate under a 90-foot head. Each pair of wheels develops 400 effective horse-power, one furnishing power for the electric street railway and the other running electric lighting dynamos. The

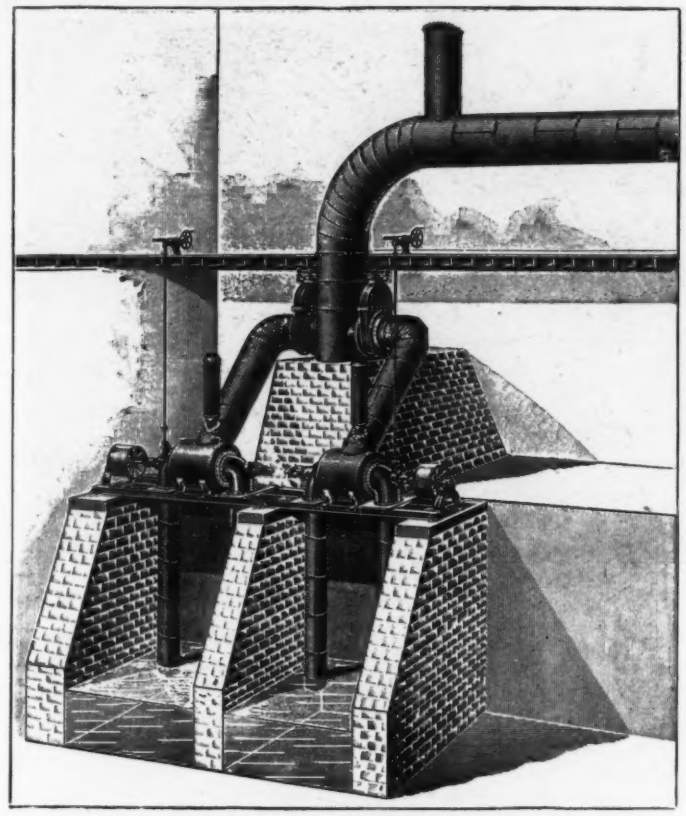


FIG. 11.—ARRANGEMENT OF ITHACA PLANT.

wheels are placed 20 feet above tail water and are supplied by a 60-inch feed flume, which extends 550 feet up the stream from the power station. The generating plant was built to be run by water power when sufficient water can be obtained and a steam plant installed to assist at other times. There are two General Electric street railway generators and one alternator, one Brush alternator, two 30-light Brush arc machines, one 65-light Brush arc machine and one 50-light T.-H. arc machine. The driving power is all connected to the same line of shafting to which the electrical machinery is belted.

The table which follows contains, as stated before, a fairly complete list of the water-power electric plants of the United States. A number of known installations have been omitted on account of inability to obtain data relating to them, and information has been received of other plants since the list was compiled. A supplementary table will later be printed including such of the above for which the necessary data can be procured.

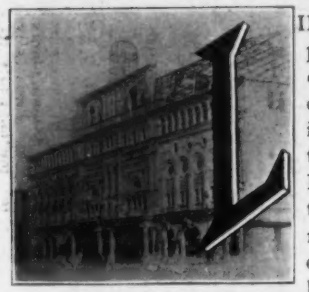
WATER-POWER ELECTRIC PLANTS OF THE UNITED STATES.

LOCATION OF PLANT.	Head of water in feet.	Water-wheels operated singly, (a).	Water-wheels geared together, (b).	Dynamos driven by common shaft, (c).	Dynamos driven independently, (d).	Additional steam plant.	Number of arc lamps.	Number of incandescent lamps.	No. miles electric R. R.	Water and steam plants coupled, electrically (e), mechanically (f).
Appleton, Wis	14	a	b	c	—	no	150	5810	3.5	—
Anaconda, Mont	140	—	b	c	—	no	170	400	2.0	—
Austin, Tex	56	a	b	—	—	no	200		16.0	—
Augusta, Ga	30	a	b	—	d	yes	300	2000	25.0	f
Augusta, Me	14	a	b	c	—	yes	250	7000		f
Allegan, Mich	9	—	b	c	—	no	12	1700		—
Asheville, N. C	31	a	b	c	—	no	150	4000	6.0	—
Augusta, Ga	31	a	b	c	—	yes	350	3300		f
Ashland, N. H	14	a	—	—	d	no		900		—
Auburn, Me	18	a	b	c	—	no	200	5000		—
Aspen, Col	875	a	b	c	—	yes	120	4500		f
Aiken, S. C	45	a	—	c	—	yes	35	2000		—
Burlington, Vt	31	a	—	c	—	yes	256	1800		f
Big Rapids, Mich	11	a	—	c	—	yes	50	1100		—

WATER-POWER ELECTRIC PLANTS OF THE UNITED STATES.
(*Continued.*)

LOCATION OF PLANT.	Head of water in feet.	Water-wheels operated singly, (a).	Water-wheels geared together, (b).	Dynamos driven by common shaft, (c)	Dynamos driven independently, (d).	Additional steam plant.	Number of arc lamps.	Number of incandescent lamps.	No. miles electric R. R.	Water and steam plants coupled, electrically (e), mechanically (f).
Brunswick, Me	17	a	b	c	—	no	70	1700		—
Bennington, Vt	48	a	b	c	d	yes	35	3500		f
Boise, Idaho	60	a	—	—	d	no	88	3000		—
Billings, Mont	13	—	b	c	—	yes	70	1000		f
Buchanan, Mich	12	—	b	c	—	no	60	1250		—
Bangor, Me	11	a	b	c	—	yes	100	5000	8.5	f
Bozeman, Mont	135	—	b	c	—	no	50	1950	4.0	f
Concord, N. H	22	—	b	c	—	yes	300	7000		—
Centralia, Wis	8	a	—	—	d	no	25	1200		—
Columbia, S. C	26	a	—	—	d	no		900		—
Clay Center, Kan	11	a	b	c	—	no	80	350		—
Cheboygan, Mich	10	a	—	c	—	no	140	1420		—
Columbia, S. C	26	a	—	c	—	yes	300	3000	10.0	f
Canton, N. Y	14	—	b	c	—	yes	45	400		f
Dover, N. H	25	—	b	c	—	yes	500	3000		f
De Pere, Wis	8	a	—	—	d	no	42	1200		—
Dixon, Ill	5	—	b	c	—	yes	60	35,000		f
Eau Claire, Wis	18	—	b	—	d	yes	200	4000	8.0	f
Eugene, Ore	14	a	—	—	d	yes	45	400		—
Elkhart, Ind	11	—	b	c	—	yes	200	2100	10 0	f
Fredericksburg, Va	14	a	—	—	d	no	37	200		—
Franklin Falls, N. H	12	a	—	c	—	no	50	100		—
Grand Rapids, Wis	10	a	—	c	—	no	25	600		—
Gorham, N. H	10	a	—	—	d	no	66	400		—
Georgetown, Col	160	a	—	c	—	yes		1800		—
Greenwich, N. Y	51	a	—	c	—	no	90	3000		—
Great Falls, Mont	40	a	b	—	d	no	160	4000	8.5	—
Groveton, N H	11	a	—	c	—	yes	12	800		f
Grass Valley, Cal	250	a	—	—	d	no	40	1000		—
Glenwood, Col	460	a	—	—	d	yes	30	1500		f
Hoosick Falls, N. Y	17	—	b	c	—	yes	104	1400	5 0	f
Hartford, Conn	19	a	b	c	d	yes	400	4000		f
Harrisburg, Pa	11	—	b	c	—	yes				f
Housatonic, Mass	20	a	—	c	—	no	15	2000		—
Holyoke, Mass	20	a	—	c	—	yes	400	1000	9.0	—
Ithaca, N. Y	94	—	b	c	d	yes			8.0	f
Iowa City, Ia	10	—	b	c	—	yes	120	1000		f
Janesville, Wis	8	—	b	c	—	no	146	700		—
Joliet, Ill	10	—	b	c	—	yes	400	5000		f
Kearney, Neb	61	—	b	c	—	yes	30	3200	4 5	f
Lawrence, Kan	9	a	—	c	—	yes	70	1000		f
Lowell, Mich	9	a	b	c	—	no	50	750		—
Laconia, N. H	10	a	b	c	d	no	100	1400		—
Le Roy, N. Y	35	a	—	c	—	yes	8	700		f
Lancaster, N. H	10	—	b	—	—	yes		900		f
Littleton, N. H	12	a	—	—	d	yes		1000		f
Montpelier, Vt	61	a	—	c	—	yes	32	450		f
Marshall, Mich	14	a	b	c	—	no	120	1200		—
Mt. Pleasant, Mich	12	a	—	c	—	no	60	130		—
Moline, Ill	7	—	b	c	d	yes	400	500	3.0	f
Marquette, Mich	28	—	b	c	—	no	100	3200		—
Merrill, Wis	10	—	b	c	—	no		1500	1.5	—
Milford, Mich	8	—	b	c	—	yes	20	500		f
Morrisville, Vt	19	a	b	c	—	no	30	1500		—
Machias, Me	10	a	—	—	d	no		750		—
Mountain Island, N. C	22	a	—	—	d	no		425		f
Matteawan, N. Y	16	a	b	c	—	yes	35	1900	4.0	f
Marseilles, Ill	11	a	b	—	d	no	50	3200		—
Middleboro, Mass	10	a	b	—	d	yes	102	1200		f
Moravia, N. Y	100	a	—	—	d	no		900		—
New Berlin, N. Y	12	a	—	c	—	yes	2	650		f
Niles, Mich	12	a	b	—	d	yes	105	800		f
Norway, Me	55	a	—	c	—	no	63	600		—
Niagara Falls, N. Y	76	a	—	c	—	no		3600		—
Nevada City, Cal	400	a	—	—	—	no		900		—
New Braunfels, Tex	20	a	—	c	—	no		700		f
Norwood, N. Y	7	—	b	c	—	yes	24	300		f
Osage, Iowa	8	a	b	c	—	yes	38	600		—
Old Town, Me	—	—	b	c	—	no	35	1600		—
Orange, Mass	12	—	b	c	—	yes	40	2000		—
Oswego, N Y	15	—	b	c	—	no	100	1300		—
Olympia, Wash	24	—	b	c	—	no	30	3000	4 0	—
Oregon, Ill	6	—	b	c	—	no		1100		—
Plattsburg, N. Y	10	a	b	c	d	yes	50	5000		f
Phœnix, N. Y	7	—	b	c	—	yes	27	800		f
Park City, Utah	126	a	—	—	d	no		650		—
Paw Paw, Mich	13	—	b	—	—	no	56	800		—
Palmer, Mass	16	a	b	c	d	yes	104	3140		f
Pocatello, Idaho	18	a	—	—	d	no	36	950		—
Red Cloud, Neb	10	a	—	c	—	no	45	650		—
Richford, Vt	11	a	—	c	—	yes	12	500		f
Rapid City, S. D	25	a	b	c	—	no	45	1000		—
Redlands, Cal	362	a	b	—	d	no	40	2500		—
San Bernadino, Cal	32	a	—	c	—	no	43	2000		f
St. Johnsbury, Vt	13	a	—	c	—	no	80	2000		—
Shushan, N. Y	7	a	b	c	—	no		500		—
Sparta, Wis	12	a	b	c	—	no	28	1300		—
Skowhegan, Me	13	a	—	c	—	no	42	2100		—
Seneca, N. Y	7	—	b	—	d	yes	175	2500	3.5	f
Sault Ste. Marie, Mich	10	a	b	c	—	yes	120	4800		f
Slatington, Pa	19	a	—	—	d	no	36	1200		—
Sonora, Cal	600	—	—	—	d	no		610		—
Stafford Springs, Conn	8	—	b	c	—		26	600		—
Sandy Hill, N. Y	12	a	b	c	—	no	48	650		—
Spokane, Wash	70	—	b	—	d	no	225	11,000	33.0	—
Sioux Falls, S. D	10	a	—	c	—	yes	40	5000	7.5	f
Sterling, Ill	7	—	b	c	—	yes	60	1500		f
Stewartstown, N. H	12	a	b	—	d	no		560		—
Turners Falls, Mass	30	a	—	—	d	no	24	400		—
Tampa, Fla	14	—	b	c	—	yes	4	1080	11.0	e
Three Rivers, Mich	8	—	—	c	—	yes	66	1500		f
Traverse City, Mich	18	a	—	c	—	no	50	2400		—
Taftville, Conn	31	—	b	c	—	yes	11	1200	13.0	e
Virginia City, Nev	420	a	—	—	d	no	94	600		f
Wymore, Neb	8	—	b	c	—	yes	20	900		f
Waterville, Me	12	a	b	c	—	no	140	3000	3.5	—
Watertown, N. Y	18	—	b	c	—	no	225	2750		—
Watertown, N. Y	12	—	—	—	—			40	5.0	—
Winchendon, Mass	16	a	—	c	—	yes	38	800		f
Waupaca, Wis	16	a	b	—	—	no	50	1200		—

A Theatre Electrical Plant.



LIKE ordinary lighting plants, theatre plants resemble one another, but the opportunity for ingenious arrangement of electrical devices is very largely increased. In this respect the installation of the new Olympia Theatre, of New York, is noteworthy, and, owing to the practical nature of the arrangements, a description of them will be of interest. In no place where electric lighting is used is it more essential to have the operation thoroughly reliable and the control more complete than in a place of public entertainment. The sudden extinguishing of the lamps might spoil a scenic effect upon which considerable capital had been expended, or, perhaps, even a serious panic might ensue. Therefore the installation must be carefully laid out and thoroughly accomplished, and the material employed must be of the best.

The boilers in the plant, of which there are two, occupy a space under the sidewalk on the northern side of the building. They are of the Campbell-Zell type, and are arranged opposite each other, with a walkway between. They generate steam at 80 lbs. pressure, using a grade of pea coal. The bunker holds about 14 tons, and the average consumption of fuel is four tons per day. The boilers are rated at 500 horse-power each. The arrangement when completed will include a slot in the side wall through which the coal will travel in a shelving pile. When a shovelful is taken from the bottom the coal will follow down and fill up the space, and thus, with mininum labor, the coal is transferred from the bunker to the boiler-room. An electrical tell-tale for the water-level is being designed for the boiler-room and will soon be put in service. The steam proceeds from the boilers through a system of piping well wrapped with an insulating covering, and passing through a Stratton separator, which relieves it of moisture, it enters the engines. There are two of these, and each drives two dynamos. The engines are of the Corliss design, and were made at the Hewes & Phillips Iron Works. They are slow-speed, running 90 revolutions a minute, and have a stroke of 42 inches, the piston being 20 inches in diameter. The power is transmitted by belts, and each engine revolves a 16-foot fly-wheel with a 38-inch face. This face is double-crowned, and carries two 18-inch three-ply belts supplied by the Page Belting Company. Thus each engine drives two generators.

The generators are four pole, and were manufactured by the Eddy Electric Manufacturing Company, of Windsor, Conn. They run at 600 revolutions per minute and are rated at 100 kilowatts each. They have an output of 800 amperes at 125 volts, but have repeatedly demonstrated their ability to carry 1000 amperes without serious heating. The commutator has 80 bars and four sets of carbon brushes, seven to a set. The generators operate sparklessly at all loads, and those in charge say that they never have occasion to shift the brushes. The commutators have a fine glassy appearance, and give every evidence of sparkless running at all times. One of the engines is shown in Fig. 1, while Fig. 2 gives a good idea of the arrangement of the generators.

Fig. 2.—Generators.

The steam passes from the engines into a well-covered system of steam piping. After having been freed from grease by a Hine & Robertson grease extractor, the steam passes to a Webster heater situated in the pump room and thence to a heating system. The entire building is heated by an exhaust steam, both direct and indi-

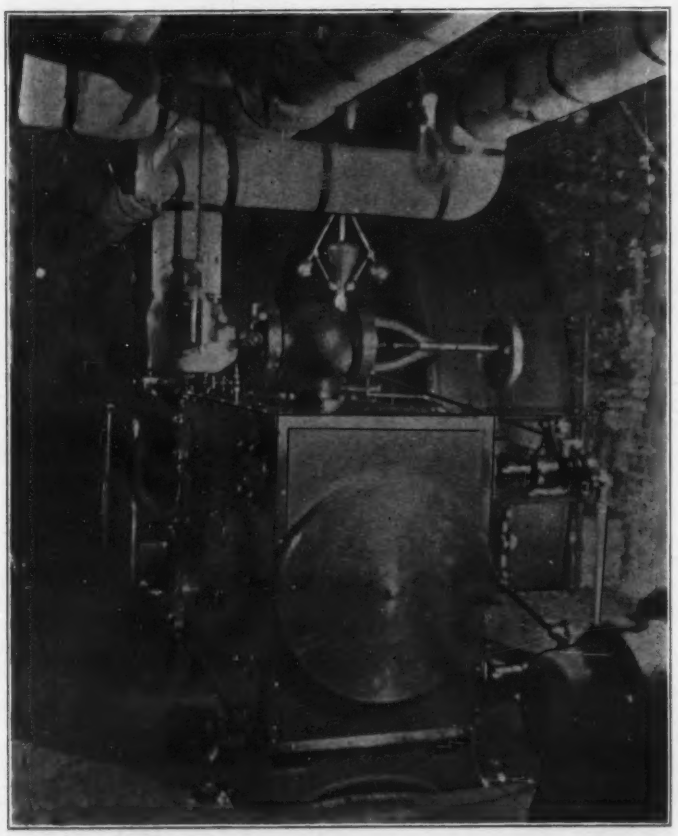


Fig. 1.—One of the Engines.

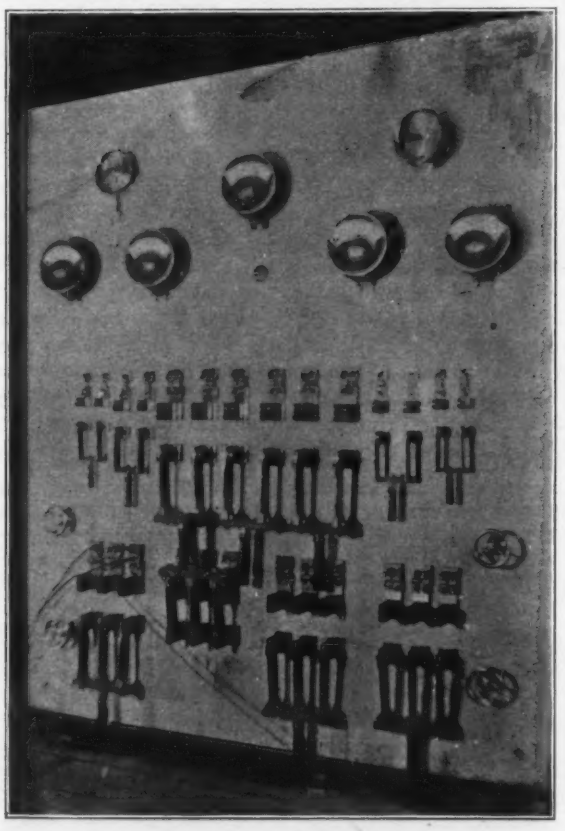


Fig. 3.—Switchboard.

rect methods being used. The condensation is received from the other end of the heating system and is pumped into the boiler. Thus the greatest possible economy of coal consumption is obtained. When the engines are not running suitable reducing valves admit live steam into the heating system.

Returning to the dynamo room, the electrical energy leaves the dynamos through suitable feeders in iron-armored conduit. This

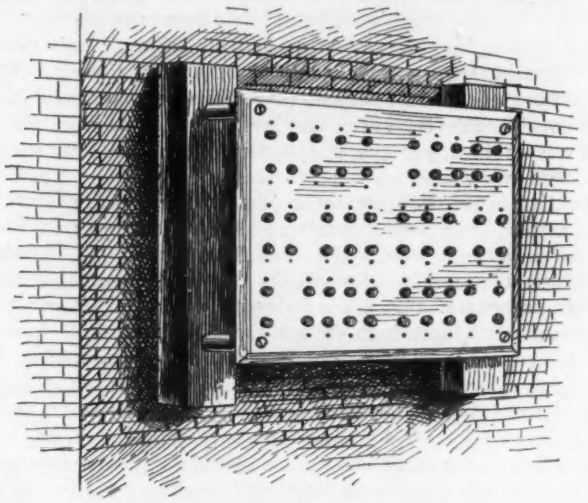


FIG. 4.—RELAY SWITCHBOARD.

construction is used in all parts of the building where especial durability is desirable, and parts which are not so susceptible to serious damage are wired on the brass-armored conduit system.

The dynamos are compound-wound, and as they run in parallel, they are provided with equalizer wires and a three-throw main switch. Four of these switches, one for each machine, are equally spaced at the bottom of the marble switchboard shown in Fig. 3. The spindles of the rheostats pass through holes in the switchboards, rheostats themselves being placed behind the board, and the controlling wheel is conveniently placed on the front. Above the main switches and rheostat handles comes a line of circuit switches. These switches, of which there are seven, control as follows: Theatre front, music hall centre, theatre centre, music hall stage, music hall front, electric sign, and the lobby. Above the circuit switches are four 1000-ampere ammeters, one for each machine, and a 150-volt voltmeter. This completes the electrical equipment. Even in its present unfinished condition the plant

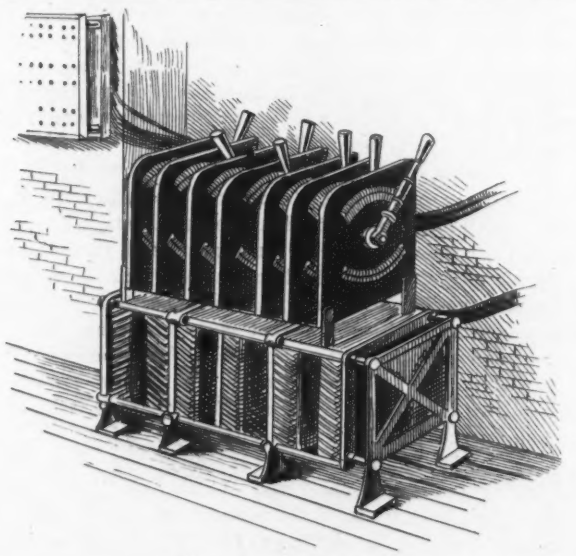


FIG. 5.—DIMMERS.

gives evidence of excellent engineering arrangement of the machinery used, and Messrs. H. B. Coho & Co., the engineers, are to be congratulated on their signal success.

The distribution of the electric power over the building is of great interest both from an engineering and an æsthetic point of view. The control of light from the stage is radically different from the usual way. An ingenious relay switch, patented by Mr. John Thompson, the chief engineer, is the key-note to the whole arrangement. The theatre and music hall are both controlled by a bank of relay switches mounted on a single marble slab 16 inches by 28 inches. The switches themselves are located in different parts of the building, as may be convenient in wiring. Aside from the cumbersome nature of the regular switchboard, which is thus avoided, the wiring to the relay switchboard involves a mere fraction of the copper that would otherwise be necessary. Further than this, the construction of the switches is such that it is very easy to gang them; that is, to have all or any number operate by the pressure of a single button. This switchboard is very unassuming in appearance, as will be seen from Fig. 4.

The lights are controlled in brilliancy by rheostats similar to that shown in Fig. 5. Each circuit has a handle swinging on a pivot, by means of which lights can be dimmed down to a faint glow. In addition, a handle swings a long bar carrying sectors to which any or all of the rheostat levers can be attached by simply a quarter turn of their handles, thereby enabling them to be operated simultaneously. The great number of combinations that can be made to work in unison is at once apparent. For instance, assuming that the theatre lighting is at full brilliancy and it becomes desirable to dim the side lights and the lights in the body of the theatre, leaving the footlights and the light in the flies burning, but not at full brilliancy. Locking all of the levers into the gang switch, the latter would be drawn forward until the footlights and the lights in the flies were dim enough. By a quarter turn of the handle controlling them they would then be left behind, and the dimming of the rest of the lights could be continued at pleasure. In like manner, an almost infinite number of combinations can be made which will work harmoniously and with pleasing effect. The main lever has an adjustable extension which can instantly be brought into play to give a greater leverage. Two projector arc lamps light each stage. These lamps are very ingenious, the design of Mr. Thompson. The carbons are at right angles and the light of positive crater is thrown directly forward without

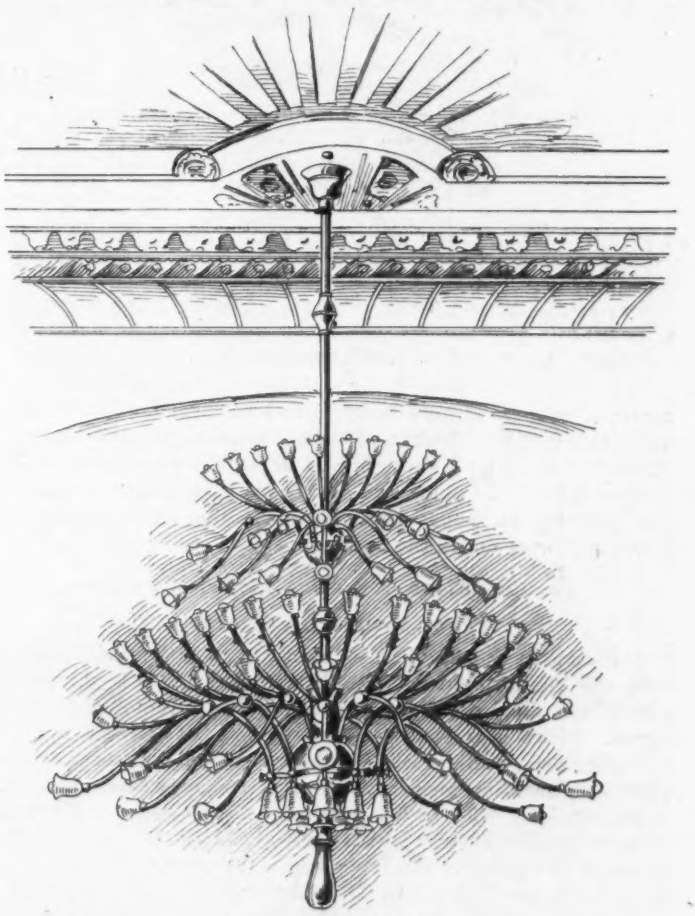


FIG. 6.—CHANDELIER.

any reflector or lenses, though of course the use of these devices greatly increases the projecting power.

The decorations both in music hall and the theatre itself are pleasingly artistic. The chandeliers, one of which is shown in Fig. 6, are hung with glass pendants, prisms and multi-faceted bulbs, and are probably the largest electric glass chandeliers in the country. The arms, and in fact all but the joints, are of glass, and are wired entirely from the inside. Both houses are lavishly decorated with papier-mache work, painting and statuary, from the smallest cherub to the 8-foot heroic figure. The theatre is finished in blue

while the music hall is finished in red. Fig. 7, showing one of the private boxes, gives an idea of the style of decoration. Besides the theatre and music hall there is a concert hall which is also elegantly appointed. Glass chandeliers and fitting decorations are everywhere, and every arrangement is made for the comfort of patrons. Lundell fans set in holes just under the pitch of the roof keep the hall well ventilated.

The total number of lamps is 4500 incandescents and 28 arcs. In addition, the stage projectors, the signs and the lights for the scenic effects constitute a variable portion of the equipment. On one scene alone of an opera 984 lights were used for decorative purposes. These

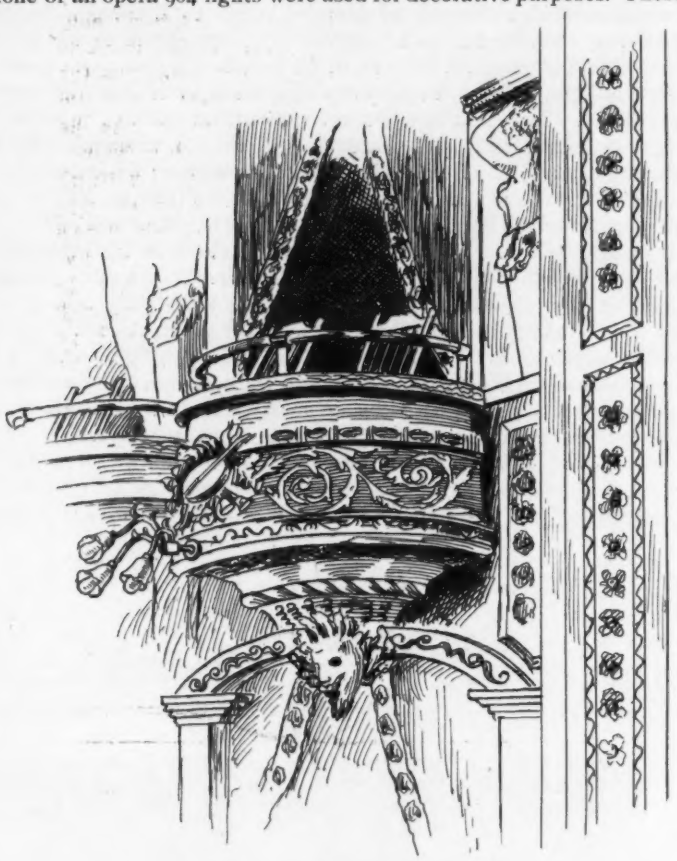


Fig. 7.—Proscenium Box.

arrangements are largely designed and executed by Mr. Thompson who has a very enviable record as a theatre engineer. He was in charge of the first lighting plant in any theatre, that of Booth at Baltimore in 1877. Since then he has been continually employed at noted theatres at similar works, thus obtaining an experience which it would be very difficult to duplicate.

The Conditions Governing Electrical Progress.

BY TOWNSEND WOLCOTT.

A somewhat popular idea of electrical and other industrial progress, which is fostered and coddled, if not actually kept alive, by a part of the daily press, is as follows: The inventor is the central figure. There is a long-felt want. For years, nay for ages, the world has been waiting, while ordinary men and that species of fools known as scientific men have tried to supply the want and failed, or perhaps have with owlish wisdom declared that it is impossible. Then comes the inventor with a divine inspiration. He takes in the situation at a glance. His brain begins to labor, and presently an invention is born into the world. The long-felt want is supplied, the aching void is filled, and, the void having gone, the ache disappears also.

Of course the regular readers of this journal do not believe in any such fairy tales, but there are perhaps some who do not realize the immense amount of error that is crowded into these few words. However much truth there may be in the oft-quoted adage, "necessity is the mother of invention," the converse proposition that all inventions are the children of necessity is manifestly absurd, and the fact that a vast majority of the inventions of the present day are not the children of necessity is a potent factor in the existing conditions of things; that is, the comparative worthlessness of the majority of patents (even those which are legally sound) and the poverty of inventors. Still, it will not do to say that a successful invention must be the offspring of necessity, for there have been instances where the demand has been created or built up after the invention is made.

The mowing machine is an instance of an invention made to fill a want. Here is an ancient and important industry which demands something better than hand labor, and some one invents a machine for doing the work formerly done by hand. So with the sewing machine; it likewise replaced hand labor by machinery. But in the case of the telephone there was an entirely different state of affairs. Here was an entirely new art. The art of talking over wire to distant places. There had been no pre-existing demand, and in fact it was a considerable time after the invention before capitalists took much interest in it, yet the telephone is one of the most successful inventions ever made.

Invention in the ordinary sense (that is, something patentable, as distinguished from other forms of original thought) is not the only factor, and frequently not even the principal one, in determining industrial progress. Sometimes one invention must wait for another before it can have any industrial value. This was the case with the electric light, both arc and incandescent. Both forms were invented years before they came into every-day use, and had to wait for a cheap source of electricity, which was found in the improved dynamo, involving the self-exciting principle and the closed armature-winding covered by the Gramme patent. To be sure, neither form of light was perfected before the commercial dynamo appeared, but the fundamental ideas were there, and the necessary improvements were forthcoming as soon as this cheap source of current was recognized.

When the great commercial possibilities of electric lighting came to be understood there was an incentive for inventors to produce dynamos which were outside of the Gramme patent, which was very broad. This resulted in the production of a type of dynamos with open coils in the armature, which answered all purposes for arc lighting and, in fact, as has since been discovered, possess some points of superiority for that purpose. But this last is a mere coincidence and not the result of deliberate design.

Sometimes a fundamental invention requires much less inventive faculty than the detail inventions, which are from a legal point of view tributary to it. This was the case with the so-called trolley. Given a source of electricity and a motor, it required very little ingenuity to think of placing the motor on a car truck, and making a sliding or rolling contact with a conductor extending along the road, and so this invention, if such it be, was made very long ago, but no valid patent was ever obtained on it. Later, when the commercial operation of trolley roads was attempted in earnest, the practical requirements of the case soon developed many particular devices for maintaining a moving contact, some of which might properly be called trolleys, and some might not, but most of them required for their production more inventive talent than the original broad idea, and yet had the original inventor secured a patent that would hold, these devices would all have been tributary thereto.

At the present time when there is a large amount of inventive talent at work in every available channel, and when there is also a diligent search for new channels, there is not much danger that the world will have to wait long for an invention it really needs, unless there is some significant obstacle in the way other than the difficulty of the mere inventive problem. For instance, there is a considerable number of persons who think that we are waiting for some great inventor to step to the front and give us a satisfactory underground trolley. Given the overhead trolley, the *idea* of the underground trolley follows as a matter of course. Not only does it not require any conscious exercise of the inventive faculty to think of it, but, on the contrary, it is impossible that any one who had to do with trolley work should not think of it at some time, provided he belong to that portion of the human race that has formed the habit of thinking at all. The room for invention is then in the direction of particular devices, or methods of accomplishing the result. There is no lack of these methods or systems, as they are called, and if one of them is successful there will probably be others successful also. The true reason that the underground trolley has not been adopted appears to be that railway managers do not see it to their advantage to adopt it. No matter how much the public would like to see it in use, or for that matter the railway officials themselves, they will not put it in if the commercial conditions do not warrant it, and these commercial conditions are largely out of the reach of invention, or even of engineering. When other conditions are favorable, there will be no lack of inventive and engineering talent to do the rest.

In the early days of telephony all, or nearly all, circuits had ground returns, and it is only in the last few years that metallic returns have become very common. The improvement in the service is beyond all question, and must be regarded as a distinct advance in electrical industry, yet who will say that any invention was required in the broad principle of a metallic return, or that electricians did not know that this simple device would eliminate the evil effects of electromagnetic induction, the chief source of disturbance.

One reason that metallic returns were not used was a mistaken economy, although some of the devices for eliminating induction which were patented would probably cost quite as much and would not accomplish the result as well, if at all. But whatever the reason or reasons for using ground returns, the introduction of the trolley on a gigantic scale rendered grounded telephone circuits in some places practically useless, and when the telephone companies found that they could not stop the trolley, they left off trifling with the question and put in metallic circuits where it was necessary. Any minor inventions such as switchboard connections which were rendered necessary by metallic returns were quickly made and would have been before had the pressure been felt earlier.

Sometimes inventors work upon impossibilities. In these days no educated electrician tries to build a motor without counter E. M. Fs., any more than he would think of trying to build a perpetual motion machine, yet many, among whom are some eminent men, have tried equally impossible things. If we admit that lines of magnetic induction are closed curves, and that electric currents must also have closed paths, it is a geometrical necessity that one cannot cut the other indefinitely in the same direction, unless one or the other is separable into parts capable of movement one upon the other. This can be and is done with the conductor in the so-called unipolar dynamos, where each convolution of conductor is separated into two parts with a relative motion between them, but magnetic lines of induction cannot be so separated, and any components into which a magnetic field can be separated still have closed paths in each component. According to this, a non-commutating dynamo with uncut coils is impossible. The writer once tried to contrive such a thing, but it was a great while ago and he had some eminent company. Another supposed opportunity is the rectification of alternating currents without commutation. Several times it has been announced that the thing was accomplished, but on examination of the supposed solutions they have all belonged to two classes: Those which were operative and involved some species of commutation (although there might have been no commutator if one chose to restrict the name to the apparatus used on the ordinary dynamo), and those in which there was no commutation, but which had the defect of being inoperative.

Since the expiration of all the broad patents on dynamos there has grown up an art of dynamo design, which is second in importance only to the invention of the dynamo itself. And yet there is no patentable invention involved in this progress, but the quality of brain work necessary for its accomplishment is of a very high order, much higher than is involved in the general run of electrical inventions. The older electricians well remember the time when the construction of a satisfactory dynamo for running 10 arc lights was looked upon as a creditable achievement, and larger ones were more or less risky undertakings. One large company up to perhaps a dozen years ago, or less, used to advise the running of 10-light machines in series rather than single machines of greater capacity. Some papers on scientific dynamo-design were published by two or three electricians, and there was an immediate improvement in the art. The more enterprising manufacturers began at once to improve their products, and the key-note being sounded, the process of evolution went on until the dynamo from a crude beginning soon came to be more perfect than most steam engines and other old machines, and from its position far in the rear, it has overtaken and outstripped commercial requirements. At the present time dynamos and motors, in every respect satisfactory, are built of the largest sizes for which there is any commercial warrant, and designers are all ready to guarantee the performance of larger sizes if any one will order them.

Really great and startling inventions and discoveries usually come unheralded, and some well-known inventors, who have given notice beforehand that they would produce a definite number of inventions in a given time, have conspicuously failed. The only predicable advances are those which depend visibly upon the same general conditions as other advances of civilization.

Probable Developments in Electricity and Electrical Engineering.

BY R. A. FESSENDEN.

It is probable that in the near future large plants will be established on the outskirts of cities where coal will be turned into gas and coke. The waste products will be made use of chemically on the spot, the coke used for such operations as necessitate its employment, and the gas sent into the cities. There it will be used for producing light and power through the intermediary of multiple-cylinder gas-engines driving electric generators. It will also be used for generating steam to be used for heating purposes, and for some cooking operations. Electricity will be used for all cooking purposes not necessitating the electrical heating of water.

The use of D. C. motors will be discontinued on street car and other work. All trains except through freight will be run by electricity. Single express cars will run at one or two minutes' headway, and at a speed of 80 to 100 miles per hour to all points within 40 miles of the large cities. The radius of manufacture will be decreased, and that of habitation increased in the cities, with a consequent decrease of cost of production and of cost of living.

Transportation and the production of power and light will be assumed by the municipalities. Incidentally this will put an end to municipal corruption, as all citizens will be so intimately affected by mismanagement of these functions that it will not be permitted.

Since using Langley's figure of one seventh watt per centimetre as the energy received at the surface of the earth on a bright Summer day, the total amount of energy received by an area 100 yards square amounts to 20,000 horse-power, it is evident that it will not be long before some means be found of utilizing it. For instance, by placing on such an area a tank with a roof pervious to heat and light, the tank containing a gas which is dissociated at the temperature obtainable in the tank and which is capable of being used, after dissociation, in a voltaic cell.

I do not think it will be many years before a new lamp is produced much more efficient than the present. It will have its power furnished to it by wires, however, and not through the dielectric, as the latter would be on a par with running a steam engine by filling the engine-room with high-pressure steam for the purpose of saving a steam pipe.

Talking across the Atlantic is, thanks to Mr. Oliver Heaviside's work, merely a matter of money. Since it is doubtful if it would ever pay it is not likely to be done.

In pure theory I believe that we are very near to a knowledge of the true nature of electricity and magnetism, of gravity, and in short of the ether generally. The capstone discovery may be made at any moment now.

We need a general method for solving differential equations, so that physical problems may be attacked without the necessity of so much ingenuity as is now requisite. Also an agreement among mathematicians as to the best form of vector methods. These will probably come in time.

Puzzled Savants.

Mr. Swinton, says "Meteor" in London *Lightning*, wisely reserves his opinion as to the nature of Röntgen rays, considering that we have as yet no sufficient evidence. "With that dictum," he adds, "I am in cordial agreement. A perusal of the correspondence this week in *Nature* is enough to dissuade any one from rushing to a conclusion; it reminds me of the old definition of metaphysics. 'A fellow talking of what he doesn't understand to another who doesn't understand him.'"

An Electric Railway de Luxe.

The Sultan of Morocco has had built a miniature electric railway, which passes through the different parts of the palace, ending in his bedroom. The equipment includes a car, in which his highness can sit comfortably and smoke while he is making his trip through the palace, which he does several times a day. The cost of this luxury is said to have amounted to $100,000.

Weston vs. Wheatstone.

With good Weston instruments a Wheatstone bridge is a useless piece of apparatus in the station, as equally reliable results can be obtained in a fraction of the time required for its manipulation.—*J. Buckner Speed*, in *The Rose Technic.*

Electrical Discharge in the Atmosphere and in Vacuum Tubes.

BY JOHN WADDELL.

The very great prominence which has lately been given to the cathode rays naturally leads one to make inquiries as to what was previously known about the subject and to what extent the new developments are based upon former knowledge.

The object of this article is to give a short synopsis of the main facts already known concerning electrical discharge, both in the air at atmospheric pressure and in gases in a rarefied condition, before Röntgen's discovery brought the phrase "cathode rays" into current newspaper literature.

Two phenomena were long ago noticed, when a powerful spark produced by a Ruhmkorff coil passes between two pointed electrodes. One is that the main spark of brilliant intensity is surrounded by a much less luminous mantle, not readily seen unless in a darkened room. Du Moncel, in 1860, and also Plücker, showed that this mantle is deflected by a strong electromagnet, while the main spark is unaffected. The mantle becomes the more distinct the greater the conductivity of the space between the electrode, whether this greater conductivity is due to particles torn off from the electrodes or to greater conductivity of the gas itself through which the discharge takes place. The second phenomenon referred to is the difference in tint, which usually appears in the spark itself, at the two electrodes. Ordinarily the positive end of the spark is purplish, and the negative bluish, but sometimes the colors are reversed, and sometimes the difference in tint is not discernible. The color appears to depend upon the density of the electric charge on the poles; for if a Leyden jar be interposed between the negative pole of the Ruhmkorff coil and the discharging electrode, the light from the latter may become as reddish in tint as that from the positive electrode, or may become even more distinctly purple. In all probability the discharge from the negative electrodes takes a little longer time than that from the positive electrode under the ordinary conditions; and this causes the bluish tint. A fact that bears upon this point is that a brush discharge takes place more easily from a negatively electrified body than from a positively electrified.

As early as 1854 Gassiot prepared tubes with partial vacuum, such as were afterward made in greater variety by Geissler and have been regarded by the ordinary student of electricity rather as matters of curiosity than as worthy of serious consideration. They have mainly been employed for providing a pyrotechnic display, to excite the admiration of the popular audience, which takes credit to itself for being interested in what it is pleased to call the wonders of science. These Geissler tubes furnish a means of obtaining a discharge, which may be considered as intermediate between that already briefly described and that obtained in the Crookes tubes, where the vacuum is much higher. In the Geissler tube the spark disappears and is replaced by a more quiet form of discharge similar in some respects to the mantle spoken of above. Some peculiarities of the spark discharge continue; there is usually a difference of color between the luminosity at the two electrodes; but the apparent dissimilarities in the mode of discharge are more noticeable than the similarities. The appearance of the discharge varies with circumstances, the shape of the tube, the nature of the gas contained in it, and the degree of rarefaction being among the modifying conditions. We may take as typical a tube of cylindrical shape, containing air whose pressure is a few millimetres of mercury. In this case round the cathode a bluish light is apparent which is separated by a dark space from the purplish light emanating from the anode. The length of this dark space varies with the circumstances; for instance, if a Leyden jar be introduced into the circuit, thereby increasing the intensity of the discharge, the dark space is made shorter. In a good many tubes the dark space is not apparent, and the purplish light from the positive pole seems to merge into the bluish light from the negative pole. A dark space is said to exist between the positive and negative discharge in the spark passing in air at atmospheric pressure, but it can only be made visible by some process of magnification.

The manner in which the purplish light proceeds from the positive pole is quite different from the mode in which the bluish light emanates from the negative. At the anode the light streams from a point, just as it does in the spark discharge at atmospheric pressure. This is quite unlike the way in which the bluish light surrounds the cathode.

The positive discharge is by far the most conspicuous phenomenon in the Geissler tube, and is usually what is examined spectroscopically. If the tube is wide, there are frequently seen alternations of luminosity and darkness, giving the discharge a striated appearance, the striæ being transverse to the direction of propagation of the discharge. The striæ are more distinct if the discharge takes place in vapors having complex molecules, such as turpentine and naphtha. They are affected by the intensity of the discharge as well as by the breadth of the tube. In narrow tubes the striæ are pressed close together and are often not distinguishable. This obliteration is aided by an irregular motion of translation along the tube. When the tube is wide enough for the striæ and their movements to be visible, the discharge seems frequently to be rotating in a spiral fashion. Goldstein, who investigated this subject, showed by using movable electrodes that, other conditions remaining unaltered, the striæ are always at the same distance from the cathode, and therefore move as though rigidly attached to it, when it is moved, while they are unaffected by the motion of the anode.

In the ordinary Geissler tube very close observation may detect between the bluish glow and the cathode which it surrounds a very narrow, dark space. This dark space is more easily detected with a disc-shaped electrode. A tube in my possession which shows the striæ very well has a dark space next to the disc, somewhat less than a millimetre in thickness.

Puluj, in 1880, described a particular experiment in which the length varied between 2.5 mm when the pressure in the tube was 1.46 mm of mercury and 22 mm when the pressure was .06 mm of mercury. The dark space, according to Crookes, is longer in hydrogen and shorter in carbon dioxide than in air. In any case the length of the dark space is much greater than the free path of the molecule of the gas at the given pressure; for instance, in the case given above, when the dark space was 2.5 mm long, the free path was less than one fiftieth of that amount. A tube of special form can be procured for showing this dark space. It has a pole at the centre in the form of a metal disc, whose diameter is almost as great as that of the tube, two other poles being at the ends. The disc is made the negative electrode and either or both the other poles positive. When a discharge is passed through the tube there is a dark space quite apparent beside the disc on one or both sides, according to how the positive connection is made. The tubes as usually provided show a dark space of two or three centimetres. A comparatively feeble discharge is rather better for the observing of the phenomenon than a more powerful one, for in the latter case reflected light is a disturbing element. Crookes' theory was that the electrified particles flying off from the cathode traverse the distance of the dark space before they are sufficiently heated by collision to become luminous. The dark space in a tube with a pressure of half a millimetre of mercury is about five or six millimetres in length, while the negative glow beyond varies in length even when the pressure is kept constant. It is independent of the position of the anode, not being bent round the corner if the tube is T-shaped, and the electrodes are in the branches at right angles to each other. The negative glow is stopped by any substance, whether conductor or non-conductor, against which it strikes; and is therefore restricted in a narrow tube.

In the Crookes tubes the pressure is measured in millionths of an atmosphere (it is said that the best vacuum for Röntgen's photography is five-millionths), and the phenomena which were most prominent in the Geissler tubes have given place to effects produced by what was obscure or even imperceptible when the gas was not highly exhausted. The dark space round the cathode is in the Crookes tubes very prominent, unless obscured by the fluorescent light which proceeds from the walls of the tube itself, or some substance in the tube. The theory of Crookes is that in the dark space matter is in the state which he calls "radiant," and that it is streaming out from the cathode, and that when it falls on substances capable of fluorescing it causes them to shine brilliantly. A screen, whether metallic or non-metallic, if placed between the cathode and any part of the tube, will screen it so that it does not fluoresce. The radiant matter streaming upon light vanes, properly balanced, will cause them to rotate. If the cathode is curved so that the radiant matter flying off from its surface at right angles would be focused at a point, any object at that point becomes very hot. With a carelessly made tube the focus may be on the glass, which will be melted, thus making the tube worthless if the discharge continues for any length of time.

It has been stated that a substance interposed in the path of the rays acts as a screen; but the question arises whether it shuts off the rays altogether. This was the question that Lenard set himself, and about two years ago he gave an account of his experiments in *Wiedemann's Annalen*, a digest of which is to be found in the

article by Prof. Oliver Lodge, published in THE ELECTRICAL WORLD of Feb. 22. It will be seen by readers of that article that a great deal of what has lately been brought forward as new has been known for some time. The question still remains whether the Lenard rays and the Röntgen rays are the same. Lenard says that the rays he investigated are deflected by a magnet, as are the Crookes rays of radiant matter, while, apparently, the rays most active in the Röntgen photography are not so deflected.

A number of experiments were made by Peace which led to the conclusion that whatever the pressure no spark can be made to pass between electrodes, unless the potential difference is something over 300 volts. The minimum potential varied little with considerable range of pressure, but at the minimum difference of potential the spark was longer as the gas was rarefied. Hittorf made experiments with varying intensity of current in tubes of moderately high vacuum, and found that the greatest fall of potential is in the neighborhood of the cathode, there being at that place a counter E. M. F. somewhat like that in an electrolyte. This accounts for the greater heating of the cathode than of the anode, a phenomenon noticed not only in the Geissler tubes, but in the Crookes tubes as well. Is this sudden fall of potential at the cathode the source of the energy of the cathode rays producing fluorescent and photographic effects?

The Röntgen Rays.

BY D. W. HERING.

A three-fold interest attaches to the Röntgen rays, apart from the purposes to which they may be applied. In the first place there are the principles of science which are involved in the nature of the radiation itself, and from this point of view the subject is of interest chiefly to the physicist. In the next place interest centres in the means of exciting the rays, and this at present seems chiefly to concern the specialist in electricity. Finally, great interest is aroused over the modes in which the peculiar action of the rays may become manifest. In so far as this action is a phenomenon of fluorescence it interests a narrow circle of scholars but in the remarkable photographic or actinic qualities it is of great interest to any person who may seek for practical applications of the rays.

The startling and sensational form in which the extraordinary possibilities of the rays were announced—capability of revealing bones within the flesh, coins within the purse, an object within a perfectly dark chamber—by means of photography, stimulated hosts of inquirers and imitators into a scientific scramble, the like of which has probably never before been seen.

It has been like a rush to the gold fields, and might perhaps recall to a forty-niner some of the incidents of that eventful period of discovery. In this instance too, as in that, it is probable that much of the final profit will be derived, not from the gold digging, but from such other interests as grow out of it. The customary period for a nine days' wonder has now expired, and the subject is returning to its legitimate bounds of scientific periodicals, physical, electrical, and medical.

A common form of Crookes tube is nearly spherical, about four inches in diameter, penetrated by several wires, which may be employed as electrodes, and one of which terminates in a metal disc of nearly one inch diameter. In the original purpose of the tube this disc was intended for the cathode, and when so connected with a source of high potential, a radiant stream from it impinges upon the opposite side of the tube, making a dark spot on the glass, surrounded by a broad halo of rich green fluorescence, which may extend over the entire bulb. This rectilinear radiant stream comprises the most energetic of the cathode rays, as usually understood, and if they fall upon a window of thin aluminum, which is more readily penetrated by the cathode rays than is glass, they can be traced several inches into the air beyond the tube, and may be deflected by a magnet. This stream is unaltered in direction across the interior of the tube, no matter which of the other metal terminals is used as the anode. A photographic plate, carefully enclosed in a light-proof case and placed near a bulb in which such electrical discharge is in progress, is blackened in consequence, and the question speedily arose whether the actinic effect was due to the cathode rays themselves, or to secondary action on the part of the tube. The question cannot be said to be satisfactorily answered yet, although the result of experiments by the writer, as well as others, point to the latter idea as probable.

Besides the stream mentioned, some radiation takes place to other portions of the tube, or else the glass of the entire bulb responds molecularly to the impacts made at the one spot, for nearly the whole bulb becomes fluorescent. When the fluorescence is strong it is found that a series of plates arranged around the globular tube are impressed photographically in not very different degrees. What slight difference there is seemed, in our experiments, to point to a greater activity upon the plates perpendicular to the stream radiated from the front side of the disc cathode, and next to that, on the plate behind the disc. Still, these test are not sufficiently numerous or exact to justify a confident assertion further than that there is no great difference on account of position.

If, under such a globular tube and above the enclosed sensitive plate there is placed an object opaque to the actinic rays, whose length is greater, and breadth less than the diameter of the bulb, the shadow on the plate will be correspondingly longer and narrower than the object.

These facts lead to the inference that the shadow is projected on the plate by rectilinear rays from every part of the globular surface, as if each point had become a centre radiating energy from it in all directions. It does not seem, therefore, as if the cathode rays proper, were the cause of the photographic effect. Hence, it might seem better on some accounts to use as the cathode a pole that is not a disc, but rather a knob or short wire.

In the tubes a good vacuum, one millionth of an atmosphere or less, is required, but whether the tubes themselves are actually necessary is not altogether certain, although attempts to dispense with them have not yet given much encouragement. Even with a good thin tube, a high potential between the electrodes is needed, and a rapid interruption of discharge is desirable. An induction coil that would give a three-inch spark produces a sufficiently high potential, and the secondary may be sufficiently excited by a primary actuated by a storage battery of twelve to fourteen volts, or a similar potential from any other source, with interruption of the circuit as slow as ten times a second. It was with just such apparatus that excellent pictures were taken at the New York University, at University Heights. With a higher frequency or with rapid alternations of the primary current the results are better.

Instead of an induction coil, the vacuum discharge may be obtained by connecting the electrodes of the tube directly with the poles of a Holtz or Wimshurst machine. With a *very thick* elongated Crookes tube thus connected to a Toepler-Holtz machine in parallel with a pair of Leyden jars, a tolerable shadowgraph was made at the University of the City of New York by one hour exposure.

This result is significant, for the material of the tube may have much to do with the effect produced. There are wide differences of perviousness to the radiation among different substances. Wood and leather transmit the rays readily, carbon partially, while glass casts almost as dense a shadow as steel. If the effect, then, does depend upon the rays passing through the material of which the tube is composed, a thin tube is much to be preferred to a thick one, and probably the same is true if the external radiation is a secondary action from the material of the tube itself. In the former case, glass is not a good substance for the tubes. For enclosing the sensitive plate in its holder, a blackened cardboard slide is fairly transparent to the rays, but does not serve well for moist objects in contact with it a long time, and close contact is necessary for correct pictures. Ebonite may be used, but probably celluloid will be found better than either. Opinions and statements of experimenters are becoming much more conservative than at first.

Although good effects with briefer exposures will be sought after, up to the present writing pictures taken with exposures of less than an hour seem for the most part to have been obtained under circumstances so especially favorable as to thinness and smallness of the object, or proximity of the radiant surfaces, as greatly to limit the possible application of the rays in photography. Much repetition of experiments must be done to gain definite information concerning penetrability of substances, concentration of the rays by reflection or otherwise, best position of plates, etc., and tubes better adapted to this specific use must be constructed, if they cannot be dispensed with. Attempts to decide these points are now the work of laboratories everywhere, and patience and time are needed before more complete and more satisfactory results can be reached. The idea that the ether vibrations in these rays may be longitudinal instead of transverse is as yet a suggestion only, and will remain so until specialized investigation shall determine the question. Many enthusiasts will discontinue their efforts, and many physicists will conclude that the further prosecution of the work requires such enlargement and specialization of equipment that they will feel constrained to leave the matter to those who can command extra facilities for research, especially as no guaranty is possible beforehand that a research will not be disappointing.

Electricity at Niagara Falls.

BY W. E. TUTTLE.

There is now in process of construction at Niagara Falls for the development of electrical power, a plant which, from the conditions of location and natural advantages, it is thought by those interested, will produce the cheapest power for the money invested of any in this country. We refer to the plant of the Niagara Falls Hydraulic Power & Manufacturing Company, in the gorge of Niagara River. From the plans now prepared, the company will build a stone power-house capable at the beginning of taking care of eight generators, two of 500 volts and 560 kilowatts capacity, and six of 280 volts and the same capacity. The six will supply current to the Pittsburg Reduction Company for its new plant now in process of construction on the top of the high bank of the gorge, directly overhead of the power house.

The hydraulic basin from which water is now taken for furnishing power to the various mills supplied with power by this company, is located parallel to and about 300 feet back from the edge of the high bank of the river. For this new electrical plant water will be taken in an open canal from this hydraulic basin to a forebay 30 feet wide and 22 feet deep, which has been built near to the edge of the high bank. From this forebay, penstock pipes built of flange steel 8 feet in diameter, will conduct the water down over the high bank 210 feet to the site of the power house on the sloping bank at the edge of the water in the river below the falls.

The site for the power-house has now been cleared; broken and disintegrated rock, mixed with huge boulders, which have fallen over the bank during the past ages, covered the site in places to a depth of 75 feet. The work of clearing this material from the site of the power-house, which is now nearing completion, has been largely done by means of a "Giant" or "Monitor." This is the kind of machine which is so extensively used in the gold mines of the West for excavating by means of a stream of water. The machine in use at this point was the first one to be used in this part of the country, and it has been of great service in this work. Below this loose debris is a strata of Medina sandstone. On this the power-house is being erected. The rock excavation is almost completed, the foundation walls constructed, and the power-house walls nearly finished to the first floor.

The building will be 60 feet long and 100 feet wide, the intention being to add to the length of the building and add other wheels fed by separate penstocks from the same forebay as above, as the demand for power appears. There will be four Leffel turbine wheels of the horizontal type, furnishing in all about 7000 horse-power, located on the first floor of the power-house. These wheels will work under a head of 210 feet, which is the highest head under which water has ever been used for power in the quantity which it is proposed to use in this plant. The pressure exerted by water under this head is enormous, and every detail of the penstock and water wheels has been designed with the greatest care to withstand it.

The penstock leads from the forebay vertically about 135 feet to the top of the sloping bank, thence down the slope to the station next to the bank, making the total length of the 8-foot pipe 240 feet. Into the building the pipe runs horizontally suspended over the tail race. The diameter of this horizontal portion of the pipe is 10 feet. From this horizontal portion of the penstock the water is taken directly up through 60-inch valves to the water-wheels, which are supported upon iron beams stiffened by braces into the side of the tail race.

Three of the four Leffel turbines are specified to generate 1700 horse-power under a head of 205 feet, the minimum head which it is calculated will be obtained, and to run at a speed of 250 revolutions per minute. As the ordinary head will be from 210 to 215 feet, the power of these wheels will be from 1800 to 2000 horse-power each.

These wheels are being built from general plans made by Mr. W. C. Johnson, who, about four years ago, also prepared the plans for the two 1200-hp wheels used by the Cliff Paper Company at Niagara Falls, he at that time acting as engineer for that company, and having charge of the design and construction of the entire pulp mill plant in which these wheels are used. This plant, which will within the next two months add electricity to its power plant instead of steam to run the paper machines, an innovation in its way, is located adjacent to the proposed new plant, and has proved highly successful in all details. It embraced several new and important features, which had not been attempted before in turbine construction, all of which, with other new and valuable improvements, will be embodied in the new turbines. Mr. W. C. Johnson, chief engineer of the Hydraulic Company, is also in charge of the plans for this work.

The eight generators will be coupled directly to the turbines on the same shaft, two to each wheel. Two of these generators are of the same type as those used for street-car traffic. The six which are to be used for the Pittsburg Reduction Company's plant have already been contracted for with the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., and are now being built. These generators will be speeded to 250 revolutions per minute and the current will be direct. The Pittsburg Reduction Company is highly pleased with its contract with the Hydraulic Company, as it will receive direct-current of the voltage (280) used in its electric furnaces. The company will also provide its own transmission wires to take the current from the generators to the furnaces. It is reported that aluminum wire will be used.

The Niagara Falls Hydraulic Power & Manufacturing Company proposes to have nothing to do at present with the alternating current. By generating direct current all the elaborate machinery of the transformer department will be done away with, with its high first cost and considerable loss in economy. With the direct current the company hopes to be able to supply customers within a radius of two or three miles with very small loss in transmission.

The principal point made by the engineers is that under this form of electrical development there is very little liability of stoppage in supplying electric current. The generators will be close to the wheels and coupled direct. The generators themselves will be of the standard type and thoroughly tested as to durability and reliability. Between the generators and motors of the customers there will be no transformers or other electrical devices liable to give out, proving, therefore, the cheapest and surest method for short transmission.

Different styles of generators can also be added for different kinds of purposes to which the electric current is to be applied. Two kinds will be inaugurated at first, one for the electric smelting works of the Pittsburg Reduction Company, and the other for short-distance power distribution. If the company should at any time desire to equip its plant for long-distance work, the power-house is so built and arranged that it can easily be lengthened, and generators and wheels suitable for that class of electric generation be added.

The two 500-volt generators which will be put in with this installation will be speeded up to 300 revolutions per minute. These generators will be used to serve small customers. The company expects to be fully equipped and running early in the Summer.

Electricity is to play an important part in the paper and pulp trade at the Falls. The announcement that the Niagara Falls Paper Company will enlarge its plant and build a sulphite addition was made a couple of weeks ago, but that Manager J. C. Morgan will call upon electricity to be one of his aids in furnishing power for the sulphite mill is now for the first time made public. It is an assured fact that motors will be placed in the sulphite plant to produce 375 horse-power. This will be an independent power and the generator will be run direct from the shaft operated by the big turbines. There was some talk of the mill adopting electricity to run its paper machines, but this would not be in line with economy, as the electrical machinery necessary to operate the four machines and other appliances will, it is claimed, cost close to $50,000.

Some time ago the story was current that the Niagara Falls Power Company, the great producer of electrical power, was having considerable trouble with the long shafts from the turbines to the generators, and was considering the advisibility of taking the dynamos and generators down into the pit and building a cave where they could be set up and run, thus doing away with the present 140 feet of shafting. It is said that the company consulted its electrical engineers, and found that although the project would be feasible, it would still be somewhat dangerous owing to the large amount of dampness surrounding the generators, and so the idea was relinquished.

Secretary William B. Rankine, of the Cataract Construction Company, which is virtually the same as the Niagara Falls Power Company, was seen at the Falls last week, and interviewed in regard to the matter. He authorized us to say, however, that his company has no idea of placing its generators underground, either in its wheel-pit or in adjacent caves, and that it "will continue to run and deliver electricity at the same old stand." When questioned as to when the contracts for the extension of the power house would be awarded, Mr. Rankine said that this would be in about two weeks. As this contract will amount altogether to about one million dollars, to be expended in building wheel-pits and in electrical machinery, it will cut quite a figure in the electrical trade. Mr. Rankine said that bids would be asked from all electrical companies willing to bid on the generators.

Telephony at Cripple Creek.

BY J. W. DICKERSON.

One of the busiest spots in the thriving camp of Cripple Creek is the telephone office, and a significant proportion of the increasing business of the district is transacted over the wires that centre in the exchange. The history of the local telephone system covers a period of a little over two years. The development of the famous mining district was due to a very great extent to the foresight and enterprise of Colorado Springs. Residents of that city, as their interest in the mining region increased, naturally desired means of rapid communication, and petitioned the Colorado Telephone Company to connect the two places by telephone wires. The company agreed to comply with their wishes if Cripple Creek would furnish 40 subscribers. No difficulty was encountered in securing the requisite number, and the work of connecting the two districts lying on opposite sides of Pike's Peak was begun. The exchange opened with nearly 80 instruments connected to the switchboard.

When the question of a telephone connection was first taken into consideration in Cripple Creek several systems were suggested, but it is not surprising that the choice fell upon that of the Colorado Telephone Company as by a connection with its admirable long-distance system was possible, a convenience that meets the needs of the district far better than a merely local exchange.

As the crow flies, the distance between Cripple Creek and Colorado Springs is approximately 20 miles, but in traveling from one city to the other the railway trains cover about 60 miles, which is substantially double the miles of the wagon road. Considering the difficulties to be overcome, the route which is followed for the pole line over the mountains is remarkably direct. It follows the Cheyenne Canon, and is 27¼ miles in length, reaching at one point an attitude of 11,000 feet above the sea level.

Since the opening of the exchange the system has been greatly expanded. Six metallic circuits between Cripple Creek and Colorado Springs are now in service, while the demand for communication with Denver has necessitated the construction of a new metallic circuit which connects with the Colorado Springs Exchange, but is reserved exclusively for long-distance communication between the mining camp and the capital of the State. The tall line wires are greatly overtaxed, especially that extending to Denver, and the company will be compelled to add to the existing facilities to meet the demand. The number of telephones in the Cripple Creek district has now reached 200, almost all of them long-distance instruments, and it is an interesting fact that only one residence is connected with the exchange. Home life on Cripple Creek has not yet reached a point of development where telephones have become a necessity.

The telephone exchange is at present located in the second story of a frame building on Bennett Avenue at the most prominent corner in the town. Directly under the exchange a wide-open "gambling joint" is in full blast, but this is nothing remarkable in Cripple Creek, where gamblers are allowed full sway in the parlors of the best hotels, and where roulette tables are exposed as freely as soda water fountains in Broadway. The quarters provided for the telephone exchange are by no means ample or adequate, but they are as desirable and as commodious as can now be secured in the mining camp, with its two or three substantial buildings and its multiplicity of flimsy frame structures, log huts and tents. The three rooms at the disposal of the telephone company are divided by partitions composed of cheese-cloth covered with wall paper. The apparatus in service consists of four sections of Western Electric switchboards and three tall tables for operating five long-distance lines.

The Cripple Creek telephone district, stretching out to the mountains in all directions, is substantially included in a circle having a radius of six miles. The service extends to all the great mines and to the principal places of business in Cripple Creek, Altman, the highest incorporated city in the world; Anaconda, Elkton, Gillett, Goldfield, Lawrence, Independence and Victor. In Victor the famous Independence and Portland mines are situated, and here on the main street of the camp a second telephone exchange was built last year to meet the demand for better service. The great majority of the calls are for places in Cripple Creek; the toll-line business is all transacted through the exchange in the last-named camp. This arrangement gives rise to complaints that residents of Victor are not as well provided for as the inhabitants of Cripple Creek. The camps are intensely jealous of each other, and upon any pretext residents of one town are ready to proclaim that they are being discriminated against in favor of those of the other. The apparatus installed in the Victor exchange consists of two sections of Western Electric standard switchboard.

Eleven operators are employed in the Cripple Creek exchange and three in that at Victor. It speaks well for the orderliness and respectability of the two camps that the company felt warranted in appointing young women as operators. In the early days in Leadville the idea of employing young women in the exchange was not entertained for a moment; indeed a revolver was hung up within convenient reach in the operating room, and it is related that on more than one occasion the weapon came in handy when some obstreperous character undertook to clean out the establishment. In Cripple Creek the operators are treated as a general rule with great courtesy by those with whom they come in contact and their experiences in dealing with the public are probably scarcely more trying than those which operators are constantly meeting in older communities. Their work, however, is more arduous, as may be judged from the brief statement of the demands on the office presented hereafter, and at the same time it is a much more severe tax on the nerves because of the altitude of nearly two miles above the sea level. It is the intention of the company to limit the work of the operators to eight hours daily, but with the existing demand for communication, adherence to this schedule is not always practicable. As the work is severe for the reasons already mentioned, and as living expenses are high, the pay of the operators is from 25 to 30 per cent. higher than that for similar work in Denver.

The mere statement that 200 instruments are in use in Cripple Creek gives no idea of the amount of business transacted by the telephone exchange; its activity is by no means comparable to that of an ordinary exchange possessing an equal number of subscribers. In the first place, the number of calls for each instrument is vastly in excess of that usual in an exchange of 200 instruments. The average number of calls per instrument is 14 daily, a number which about equals the average in cities of the class of Chicago and New York, and is almost double the Denver average. The explanation of this unusual demand is not difficult to discover; the number of business deals necessitating conferences between interested persons is beyond all calculation; with one exception the instruments are located in places of business, and as walking on the mountain side is tedious persons prefer to communicate by wire instead of face to face. Six operators are engaged in the toll-line service, and they are kept extraordinarily busy in answering calls.

The business on the toll lines starts late in the day, but it keeps up until 10.30 p. m., and even after that hour persons anxious to communicate with Denver rush into the office. At 9 o'clock the little room which is provided for the public, and which opens directly into the operating room, is ordinarily crowded by those demanding immediate communication with Denver or Colorado Springs, to consult or report concerning mining deals or stock operations. Two long-distance telephone booths are arranged for the public, and these differ from the regulation pattern to be seen throughout the country, in that they are built of common pine boards. The construction of oak sound-proof booths, according to the standard Bell pattern, would be, in the language of Cripple Creek, "too large a proposition" for a mining camp, while booths built elsewhere would be badly battered if carried as freight during the existing rush.

The separation of the apartment for the public simply by a low rail from the operating room is by no means a desirable arrangement, although no better plan can be devised under the existing conditions, for the extension of the present quarters is not feasible. While the crowds which throng the room treat the young women politely as a general thing, yet they are so intent on securing the use of a wire and so bitterly disappointed if their wishes cannot be instantly granted that they are constantly tending to interfere with the work of the operators by distracting their attention from their work. The latter, however, as a rule keep remarkably cool, collected and courteous and do not allow themselves to be "rattled" by the eager persistence and clamor of the impatient crowd outside the railing.

Three boys are employed in the Cripple Creek office to summon to the instruments persons who are called for at various points on the long-distance system. The messengers cannot always locate their man, but it is marvelous that they succeed as well as they do. The houses are scattered about in an irregular fashion; there is a lack of street numbers even in the oldest parts of the camp, and the hotel lobbies are crowded so tightly during a large part of the day and evening that the discovery of a person known to be registered could result only from a lucky chance. Another difficulty in finding persons in the Cripple Creek district is explained in these words in the preface of the local directory: "The miners in many instances

refused to give their names for, as they stated, good and sufficient reasons." This statement might be interpreted in a way that would not be entirely flattering to Cripple Creek. Still another trouble results from the common designation of the probable whereabouts of the desired person as "in ———'s saloon or if not in some other saloon." Cripple Creek is plentifully supplied with resorts of this description, and to find a person by means of such information is not much less difficult than to locate the proverbial needle in the haystack.

One comment that is frequently made when a report is sent over the wire that a certain person desired at the telephone cannot be found, is always irritating to the operators. "Oh, you must be able to find him," as it is usually expressed. "He is a mining man, and he has a mine on such and such a hill." "If" said the manager of the exchange recently, "the desired person was not a mining man, and if he was not interested in some property on a hill hereabouts, the description would be much more definite and serviceable."

The fact that Cripple Creek has grown so rapidly and has therefore been thrown together in such a tremendous hurry, has caused the utmost confusion to exist in reference to street lines, grades and kindred matters. A line of poles finished today may be ordered away to-morrow, because of changes decided upon by the city authorities. In Poverty Gulch, for example, the grading which is now in progress will bring up the street level almost up to the cross-arms. Changes have been made at several points, so that heavily loaded teams, especially those carrying hay, cannot pass under the wires. Modifications in street lines have brought poles into the planking of the sidewalks, or perhaps have left them in the gutters. Corresponding changes must be made in the locations of poles to conform to changes of this sort, although alterations are exceedingly costly in Cripple Creek, where a lodgment for a pole is obtained only by blasting five feet deep in solid granite. Blasting for a pole, however, does not signify to any great extent in Cripple Creek, where the reports of blasts from one direction or another are almost constantly heard. The operation of blasting for pole-holes is curiously conducted. When the preliminaries have been arranged the workman lays two cowhides directly over the hole, and on top of them places several logs chained together. This protection prevents the explosion from causing damage, as the skins are sufficiently tough to escape puncture by any of the flying bits of rock.

In all the blasting, however, even in that in proximity to the business district of the camp, caution is not invariably exercised. A blast near one of the telephone lines a few days ago broke a number of glass insulators and badly dented some of the cross-arms. As the foreman of the telephone construction gang remarked to the writer, "They keep throwing stones all over this town." To see a dozen sticks of giant powder propped up against a building, with no one near by to look out for them, is by no means an uncommon sight.

In making the extensions as the telephone system expands and in making alterations as grades and street lines are changed, the construction gang is kept busy in Cripple Creek. The work progresses slowly for the reason that the linemen, owing to the altitude, are soon fatigued. Much of the work is done on the mountain side, and by the time the workman reaches the scene of his labor he is nearly exhausted by his tramp on the steep ascent, and is more ready for rest than for exertion. After climbing two or three poles the lineman begins to puff and blow and finds it necessary to rest before starting anew. The construction gang narrowly missed a small fortune in building the pole line from Cripple Creek to Gillett, which lies at the foot of Pike's Peak. One of the poles was buried in a spot which was subsequently included in a mineral claim, and a considerable body of ore has been taken out from the very point where the pole was located. Had the men been as expert prospectors as they are linemen they might have secured a very pretty sum for their find.

Standard Electrical Rules.

To the Editor of The Electrical World:

Sir:—In your admirable editorial on the subject of "Standard Electrical Rules" in your issue of Feb. 29, 1896, you state the following:

"We note, by the way, that the body just named is not represented among the organizations invited to participate in the preparation of the proposed code. Why it should have been refused recognition would seem, in view of the public nature of the object to be attained, to demand explanation. The body is a national organization similar to many of those represented in the list we print; during the three years or more it has been in existence, the systematic study of the requirements for the safe construction and operation of electrical installations has been an object uninterruptedly pursued by it, and rules formulated in accordance with the conclusions arrived at have exhibited a creditable spirit of fairness toward the industries affected; as far as we know, its code has not been subjected to adverse criticism as a whole, and is now in general use throughout the United States. But few of the bodies to be represented in the joint conference could speak with greater authority from the insurance point of view as to the requirements to be observed in the formulation of a code of rules such as proposed, and what is more important, its members in their character of electrical experts to the more important underwriters' association throughout the country, will wield the greatest influence for or against the adoption of that code for insurance purposes. As favorable action by the insurance interests on the proposed rules would not only destroy their own work of years, but also, should their organization not be represented, discredit them personally, it would not be surprising in the latter event if their influence should prove adverse. The general adoption by the insurance interest of the code to be prepared next month by such a competent body of experts would be a great boon to the other interests affected, and it therefore seems unfortunate that the complication to which we have referred should have been introduced in the preliminary stage. It is not yet too late, however, to retrieve what cannot be considered otherwise than as an error. Since the delegates of the several organizations to be represented at the joint conference have a direct interest in any question affecting the outcome of their labors, this is a matter which might well form the subject of action on their part."

There is considerable wisdom in the case as presented by your editorial, and on behalf of the Committee of the N. E. L. A. I wish to state that there has not been for a moment any intention of ignoring the work which has been done by the insurance interests or belittling the importance of any of the insurance organizations, of which there are, I have been informed, over 200 in the United States. In the original report which was sent out by our committee it was stated: "That in view of the very large number of electrical, insurance and other boards, companies, societies and associations, as well as individual consulting engineers and experts, who are manifestly interested in and affected by work of the character proposed by said joint committee, and as it will be impracticable to invite all such organizations or individuals to co-operate, it is deemed advisable to limit the invitation to national organizations and companies which are practically national in the scope and character of their work."

The committee have decided that the representative body of the insurance interests being the National Board of Fire Underwriters, that the invitation should be extended to them, and in my letter to them as chairman I suggested that perhaps they might deem it advisable to send a delegate to represent them from the Underwriters' National Electrical Association. They appointed Mr. William H. Merrill, chief electrician of the National Board of Fire Underwriters, and a prominent member of the Underwriters' National Electric Association. In this connection I may state that our committee had decided some time ago, in addition to inviting the national organizations already referred to in your issue of Feb. 29, to send a limited number of complimentary invitations to certain gentlemen who by reason of the character of their experience, the nature of their occupation, their identification in the past with work such as the proposed joint conference will consider, together with their prominence in electrical engineering matters, would warrant their being invited in their individual capacity to attend the proposed joint meeting on March 18 and 19 and lend their co-operation and assistance in the preparation of the standard code of rules. As I stated to the editor of The Electrical World last week, this had already been decided upon, but the committee had not finally completed the list of complimentary delegates, but I stated to him at the time that this would comprise several of the most representative men of the Underwriters' National Electric Association. Our committee has also been criticised for having invited but two of the electric lighting companies, and after considering quite a number of those prominent in the industry, it was deemed desirable to invite two of the leading exponents of the direct and alternating systems of electric lighting and power, believing that they would carefully conserve the interests of the electric lighting industry in general. I shall take pleasure in sending The Electrical World the list of complimentary delegates as soon as our committee has completed its final report.

William J. Hammer, *Chairman Com. N. E. L. A.*

New York.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

DYNAMOS, MOTORS AND TRANSFORMERS.

Theory and Calculations of Non-Synchronous Motors. HEYLAND. Lond. *Elec.*, Feb. 14.—The first part of an article describing comparatively simple, graphical and analytical calculations, the present portion dealing with polyphase motors. It is practically the same as the article mentioned in the *Digest*, Nov. 3, 1894, under "transformers."

Theory of Three-Phase Motors. BLONDEL. *Elek. Zeit.*, Feb. 13.—A brief communication pointing out a simplification of the diagram in the article of Behrend (*Digest*, Feb. 22). He believes that this method is adopted for extremely accurate calculations and that it will be very useful in practice.

Comparison Between Continuous and Polyphase Motors. DUEZ. *Jour. Inst. Elec. Eng.*, February. Abstracted briefly from *Comptes Rendus*, No. 3, p. 160.—He points out the analogies between continuous-current and polyphase-current motors in the formulas for their calculation.

Alternate-Current Transformers. FLEMING.—His fourth and last lecture is abstracted briefly in the English journals, Feb. 14, and is devoted largely to the subject of testing.

LIGHTS AND LIGHTING.

Arc Lighting Progress. HESKETH. *Elec. Eng'ing*, February.—Abrief article supplementing that of Mr. Dow (*Digest*, Jan. 4), giving an English engineer's views on the subject. They have not generally used single machines of over 30 kilowatts, and the need of 100 lighters has not been felt; they think by far the greatest factors are reliability, flexibility and freedom from trouble; he praises very highly the rectifier of Ferranti, which he considers a step in the right direction; one of the largest is a 60 lighter, and is doing work at his (Blackpool) station, replacing the Brush machine; the advantages are very apparent; in practice the fancied troubles which are thought must exist do not appear, as it gives no more trouble than an ordinary circuit for incandescent lighting; the efficiency of one of the earlier types was 86 per cent., 85 per cent. of which gives 73 per cent., which is 25 per cent. higher than that of a 55-light Brush machine; there is also less cost of repairs, as the rectifier practically involves no repairs. The use of the alternating arcs has not been very extended in England; more attention is given there to æsthetic details; great advances are looked for in the distribution of light. Curves are given showing the total luminous flux of 10-ampere arcs at various voltages, with different sizes of carbons, from which it appears that if carbons eight and six mm in diameter are used, instead of 18 and 14, the illumination is increased 250 per cent.; with six amperes and properly proportioned carbons, a better light can be obtained than with 10 amperes and the carbons used at present.

Cost of Isolated Lighting. METCALF. *El'ty*, Feb. 26.—A short article discussing the question of whether the cost of isolated lighting can be reduced. He calls attention to the importance of testing the incandescent lamps and the objections to the published reports of such tests; to be of benefit to a consumer, the data contained in such tests should be reduced to actual cash values; he gives a table of such deductions for the tests of European lamps recently published in that journal and deduces the cost of the light per cp-hour, which he considers shows the relative values of different lamps; he shows that with the same number of renewals, and the same length of life, the worst of these lamps will cost over 42 per cent. more than the best, on a basis of 12 cents per kw-hour; the saving between these two in one year would more than pay for the apparatus and labor necessary for testing and systematically inspecting all the lamps in use in a building; he recommends keeping systematic records of the steam, dynamo and lighting plants, and of replacing lamps which are dimmed; also of properly testing the lamps and replacing them at the best life.

POWER AND HEAT.

Water-Power Installation. L'Ind. Elec., Feb. 10.—A well-illustrated description of the Zufikon-Bremgarten installation in Switzerland, in which the falls of the Reuss River around a large curve are utilized by means of a large tunnel cutting off the curve; the total power is 1300, and it is at present used to supply power to three large establishments in the neighborhood; there are four direct-coupled, three-phase generators, with vertical shafts, developing directly 2900 volts per phase; the frequency is 50.

Electricity in Mining. Elec. Friend (Japan), January.—In the Ashio copper mine horse cars are used for a distance of 7000 feet from the outlet to the mine proper, where there is a 25-hp electric motor for the 360 feet vertical shaft and 80-hp electric pumps; the generator is driven by a Pelton wheel; a 25-hp Siemens motor car is used on the steep grades for some distance outside of the mine.

Individual Electric Motors. OBERLIN SMITH. *Elec. Power*, February.—By individual motors he means those which are arranged to drive an individual stationary machine; the object of the article is "to take a general glance at the up-to-date development of the electrical system in question"; he has for a number of years favored the smallest possible motor units; according to Richmond the cost of power in an average machine shop is only about 1 per cent. of the cost of the wages, but this factor becomes practically of little importance when the various advantages of electric driving are considered, as the labor may thereby be made considerably less and more efficient; he enumerates the advantages of individual motor driving, and expresses the belief that it is only a question of time, and perhaps a comparatively short time, before individual motors will be introduced into new shops; the chief retarding influence is the present high cost of small motors.

Electric Motor for Organ Blowing. SHARPSTEIN. *Elec. Eng.*, Feb. 26.—A description of how to install electric motors for organ blowing, with special reference to the method of controlling in order that the motor will act promptly and reliably.

Mechanical Connections Between Engines and Dynamos. CROCKER. *Elec. Power*, February.—A general discussion of the different ways of transmitting the power from the engine to the dynamo.

Electric Heating. HADAWAY. *Elec. Eng.*, Feb. 19 and 26.—An abstract of a paper read before the American Society of Heating and Ventilation. The general subject-matter seems to be the same as that of another paper by the same author, which was abstracted at some length in the *Digest*, May 18, 1895. He divides heating into two classes according to the degree of the concentration of the heat energy used, the first including low temperature heating generally diffused and in large volume, and the second including high temperature heating generally localized and in small quantity; he calls the first a multi-potential heating system, in which steam and electricity are the means of transmission, and the second a constant-potential heating system, in which electricity is used as the agent for diffused heat in large volume; the first is in use, but the second is more difficult and includes new methods of application and untried apparatus.

Heating. TALBOT. *Elec. Rev.*, Feb. 26.—Beginning of an article discussing the relative merits and costs of electric and coal heating.

TRACTION.

Continuous Rails. GUILLAUME. *L'Ind. Elec.*, Feb. 10.—He shows briefly, from a theoretical standpoint, why it is that the use of continuous rails is possible; he shows that during expansion the rails may make a number of small deflections which will take up the expansion, but they are not sufficient to be noticed.

Aix-la-Chapelle. L'Elec., Feb. 15.—A brief, illustrated description of this line. The Lond. *Elec. Rev.*, Feb. 14, publishes a brief description.

Rapid Transit Investigation. BARNES. *Elec. Ry. Gaz.*, Feb. 15.—A summary of the opinions expressed by him before the Supreme Court commissioners with reference to the lines in New York City. The motor of an electric locomotive is identical in design with that of the ordinary trolley cars, differing only in non-essential details; the weight of an electric locomotive is less than half that of one for steam, of the same capacity; a stationary plant located at the river's edge could generate at the station the same total power as steam locomotives at about half the cost for coal; a train could be operated at 60 miles an hour if the stations were a mile apart; he does not favor the plan of equipping every car with motors on account of the complication in wiring and the greater first cost of rolling stock; he sees no difficulty in operating electric cars on such a road (presumably the New York elevated) at an average speed of 40 miles an hour; a seven-car train having one motor car could be brought to a speed of 60 miles an hour within 47 seconds, on a level track and within a distance of 2700 feet; for 40 miles an hour it would require 32 seconds and 1200 feet. The cost of changing the present elevated road to be operated by electricity he estimates at $8,000,000, and he thinks the saving in operating expenses would reach 25 per cent., which he bases on the experience of the Chicago West Side road; the complete electric plant would cost between $4,600,000 and $6,700,000, according to the number of cars, speed, etc.; the central station equipment for 20 express trains, with an output of 8400 hp would be $504,000; the central station equipment for 150 local trains, requiring 23,000 hp, would be $1,380,000; the cost of an

express train of five cars would be $16,500 and a local train of three cars $11,465; conductors, $715,000; the cost of equipping a passenger coach with motors, $4000.

The same journal contains an interview with Mr. SPRAGUE on underground rapid transit in New York. He does not think the use of electric locomotives as used in London and Chicago is the method of application which will ultimately be adopted; the question of economy of operation depends on the number of units between the terminal points; if sufficiently large, electric traction is the best system whether for high or low speed, but if the number is below a certain point, then the steam locomotive is the more economical; he thinks that no system heretofore made public will finally be adopted on this road; he considers that the best system is a combination of the surface car and the present elevated systems, that is between single units and train units; the essentials of such a system are to keep the train intervals as nearly constant as practicable, and have the train lengths vary according to the traffic; to have the distribution of motor power both in weight and amount, in motion, directly proportional to the number of cars in operation, which means the abandonment of the locomotive system; to have as nearly as practicable an even distribution of duty over a line; to meet this there is only one method, that is the equipment of each car with its own motors and the provision of means for controlling from one point on a train any desired number of cars; this he thinks is practicable and will be the system of the future, and it settles the express and way-train question. For cars like those on the elevated road the weight of each unit, including 80 passengers, would be 20 tons; stopping and starting would be much more prompt; a 5-car train as now handled by a 22.5-ton locomotive develops 184 hp, while a 20-ton electric car to perform the same duty would require only 40 hp; the individual cars need therefore be equipped with only 50 hp in motors, which is the same as that in common use on many surface lines. He advocates the use of a continuous-rail contact which may be overhead in the tunnel; power stations would be near the water's edge; 600 to 700 volts would be used; the storage battery carried on the car would be entirely out of place, but he thinks it would be useful as a regulator to take care of the fluctuations on the line, it being placed at 3 or 4 centres of supply along the road; the average power would be 18,000 hp.

Electric Traction on Railways. BAXTER. *Elec. Eng.*, Feb. 26; a continuation of his article (*Digest*, last week).—He discusses the coal consumption on steam and electric railways with a view to showing that the difference is not as great as has been claimed by others; he claims that the coal consumption of locomotives will average 4 pounds per hp per hour for express engines, 5 for local passenger and 6 for freight; the cost of a unit of energy developed on the track by electric motors would be about 44.5 per cent. of what it is with steam locomotives, as far as the coal bill alone is concerned; the saving in favor of electricity would be 4.44 cts. per train mile, and as the average yearly run of a locomotive is about 30,000 miles, the annual saving in coal per locomotive would be over $1,300, which is not enough to make the adoption of electricity justifiable on roads now in operation; he enumerates some of the incidental advantages of electric traction, which, taken all together, he considers will go far toward offsetting the cost of power-stations, trolley lines and feeders, and he thinks that a close estimate for equipping a new road would show only a small percentage in favor of steam, so small that the reduced cost of operation due to the saving of coal would render the electric system more profitable, except where coal is very cheap. From the reports of 10 of the largest steam roads he deduces a table of figures showing the operating expenses, the coal consumption and the mileage for passengers and freight separately, and deduces from this the percentage that the coal bill represents the total operating expenses in each case; this appears to average about 10 per cent., being as low as 6 in one case, and as high as 18 in another; he shows that the coal-consumption of freight locomotives is much greater per hp than the figures claimed for high-speed passenger engines, and also that the opinion generally entertained that electricity would not have much of a chance competing with steam for freight service is not well founded, and he believes that if it can compete with steam at all it will be for heavy freight traffic; on account of the slow speed of freight locomotives he believes the efficiency is much lower, and in addition to this such locomotives are often sidetracked for a considerable time, during which coal is burnt without doing work.

Locomotive. Elec. Eng., Feb. 26.—A brief description of the new Westinghouse-Baldwin locomotive, accompanied by an illustration showing the exterior. All the operating parts except the controller have been placed on the trucks, and the body of the car which resembles that of an ordinary railway car, though so much shorter, may be used for baggage, passengers or freight; the car is 38 feet long and 9 feet across; the description states that the truck contains eight wheels, but the illustration shows two pivoted trucks of four wheels each; the latter are 42 inches in diameter; there will be four motors of 200 horse-power each, and they are geared to the axles; the total weight completely equipped will be 160,000 pounds and the total cost $16,000; it is said to be a regular passenger engine rated at 1000 horse-power and will be capable of running at a speed of 75 miles an hour and even up to 125 if necessary; it is equipped with air brakes driven by electric motors.

Operating Expenses in Chicago. Elec. Eng. Feb. 26; reprinted from the Chicago *News*.—A few deductions from the reports for the last year. On the north side of the city the trolley cars are now being operated more cheaply than the cable cars; on the south side the cost per car mile for the cable cars rose from 9.972 in 1894 to 10.240 in 1895, while for the electric cars it fell from 16.904 to 14.776; the passenger traffic on the south-side cable lines diminished over one million passengers, while on the electric lines there was a large increase; "it is not unlikely that the results of the current year will point irresistibly to the discarding of the cable as a means of street-car locomotion." The data from these reports is given in abstract in the *St. Ry. Rev.*, Feb. 15.

Electric Traction on the Brooklyn Bridge. Elec. Ry. Gaz., Feb. 15.—A brief report of the recent tests, which were completely satisfactory to the president and engineer of the Bridge Company; the motor cars will remain with their trains, switching them from one track to the other; the motors exert a horizontal effort of 1200 pounds when used with a 33-inch wheel; four of these are used on each double-truck car; each motor weighs about 3000 pounds.

Ordinance Regarding Electrolysis. Eng. News, Feb. 27.—A reprint of the ordinance passed by the City of Richmond, Va. The principal points are as follows: the rails should be electrically welded at the joints, or, if separated, they shall be bonded; for 10 to 60 pound rails one bond of No. 0000 shall be used; for 60 to 90 pounds they shall have two such bonds; where joined the rails shall be drilled, the bond threaded and secured to the web with copper washers and an iron nut, the surface of the rail being first cleaned; the contact shall be made with bright surfaces and shall have not less than 10 times the area of the bonding wire; the outside shall be thoroughly painted with insulating paint; every third rail shall be cross-bonded with a No .0, copper wire; a continuous supplemental wire shall be laid in the centre of each track and connected to each rail every 300 feet; the size of this wire shall be equal in area to that of all the feeders for that section; in all cases the rails are to be connected to the negative bus-bar; when the current is returned from the track to the power station there shall be provided and maintained a metallic circuit of old rails bonded together, or some similar metallic return of ample area; under no conditions shall the current be grounded at any point near gas or water mains; whenever a volt or ammeter indicates a current from the gas or water mains to the rails, steps must be taken to stop it, a fine being imposed for non-compliance; if any damage is done to the water or gas mains the company shall be held liable to the city.

Electrolysis. STORRS. *Prog. Age*, Feb. 1.—He gives a brief statement of some of the practical information on the subject, taken from publications during the last year, and adds some hints. He divides the subject into remedies for existing roads and preventative measures for proposed roads, and adds some legal aspects of the subject. He considers that every direct-current system using a conductor in contact with the ground is dangerous to underground pipes; he thinks the single-trolley system will be used for some time to come, unless State or municipal authorities regulate the matter. He considers it difficult to see how railway companies can escape the charge of negligence and responsibility for resultant injuries, if after being notified they fail to adopt remedies.

Emergency Brake. PARSHALL. *Elec. Eng.*, Feb. 26; a brief, illustrated description.—It consists simply of two curved shoes held by levers in front of the wheels and operated from the platform in such a way as to be forced in front of and under the wheels, thus lifting the wheels clear from the track, thereby preventing the grinding of facets on them; the shoes are provided with a bead which fits the rail so as to prevent derailment.

Electric Railways. Elec. Rev., Feb. 26. A brief outline of the West End system in Boston, and its operation.—The *Elec. Ry. Gaz.*, Feb. 15, contains a brief, illustrated description of the Schuylkill railway plant; the issue of Feb. 22 describes the system at Reading, Pa., with some illustrations.

Electric Traction. DAWSON. *Elec. Ry. Gaz.*, Feb. 22.—A reprint of the article mentioned in the *Digest* last week.

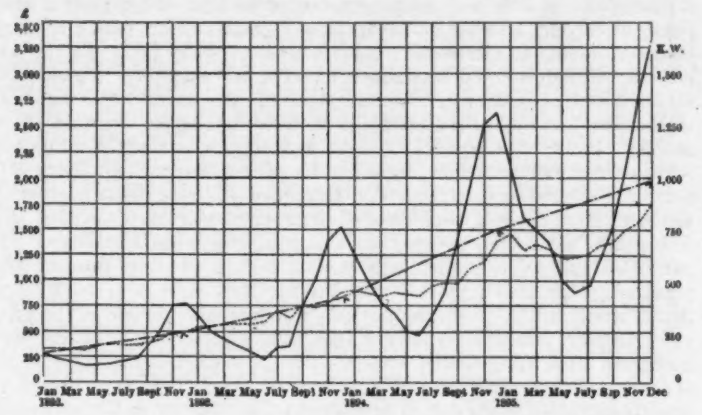
Road Carriages. Eng. News, Feb. 27.—An editorial article with illustrations on "Recent Developments in America, of Mechanically Propelled Road Carriages."

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Gas Engine Station for Block Lighting. Lond. *Elec.*, Feb. 14.—A brief extract from the *Gas World* concerning a small station in Frankford, Germany, in which a block of buildings is supplied from a 70-hp gas engine without any of the costs of distribution to a distance; storage batteries are used; the number of lamps correspond to 2200 of 16 candle-power each, of which 1800 are burning simultaneously during several hours; the consumption is 490,000 ampere-hours, or 445 hours per lamp; the total cost, including everything, amounts to $4475, or 0.4 cent per 16-cp lamp per hour; it has paid a 7.5 per cent. dividend after allowing for depreciation, etc.

Central Station Curves. Lond. *Elec.*, Feb. 14.—Two curves of some interest are given, being based on experience at the Brighton station, and deduced, apparently, by Mr. Wright, whose system of charging for current is well known. One of these, which is reproduced in the adjoining figure, shows how much more nearly the expenditure of a municipal station varies in accordance with the maximum rate at which it is called upon to deliver in each year, than it does on the total number of units sold in any month during that year; "the moral of this curve is obviously

that the total monthly expenditure is very closely a linear function of the maximum rate at which electricity has to be supplied in a given year, and that it is in no very obvious way a function of the monthly sales"; those who advocate charging a uniform rate, it is said, may be unaware that in most stations it is generally found that the total fixed expenditure of standing charges are quite 85 per cent. of the total annual expenditure.



The other curve is of interest in deciding on the probable size of units, and seems to justify the English practice of splitting up into many units of dissimilar size; it gives the number of hours in a year "that a station, which has arrived at a certain stage of steady growth, will be called upon to supply a load exceeding any given percentage of its maximum load"; a load of 95 per cent., for instance, of the highest observed in the year, was continued for only 5 hours out of the total 8760 while for 1500 hours, or nearly one fifth of the year, the station had to deal with a 25 per cent. load.

Regulating the Phase of Alternating Currents. BERG. *Elec. Eng.*, Feb. 26; a brief, illustrated description.—The object of the apparatus is to respond to a difference of phase between the current and the E. M. F. and correcting the distortion; it consists of a synchronous motor connected between the lines, the excitation being controlled by a resistance which is in turn controlled by a solenoid in series with the synchronous motor: "opposing this current device is a watt mechanism" the power of which is balanced by that of the solenoid when there is no difference in phase, but if the current lags, the difference becomes larger and the solenoid will then exert more force than the watt mechanism, thereby changing the resistance of the excitation circuit, which in turn will restore the phase relation of the current.

Current Controller. ADAMS. *Elec. Age*, Feb. 22.—An illustrated description of an instrument to prevent the consumption of electric power beyond a certain predetermined limit, when the current is supplied by power companies; the device "consists briefly of the substitution of a fuse calculated for running purposes for a fast rated for starting;" a magnetic device substitutes momentarily a larger fuse, the time taken for this substitution being made equal to the interval required by the motor to attain its speed.

Lightning Arresters. GARTON. *Elec. Eng.*, Feb. 19; a reprint in abstract of a paper read before the Chicago Electric Association.—He calls attention to the detrimental effect of coils and bends in the wires leading to lightning arresters, which alone in many instances completely counteract the good influence exerted by the arrester; he cites a case in which the arrester was unsatisfactory, but on straightening and shortening the wires its action was quite satisfactory; he recommends inserting as much hindrance to the discharge as possible between the apparatus and the arrester; inductive resistance is the most formidable enemy of high frequency currents.

WIRES, WIRING AND CONDUITS.

Wiring. Jour. Inst. Elec. Eng., February.—The complete papers of Mavor on "Concentric Wiring," and Bathhurst on "The Electrical Wiring Question," both of which were abstracted in the *Digest*, Dec. 21.

Insulated Wire Cable for Mines. GUILLEAUME. *Elec. Eng.*, Feb. 26.—A brief, illustrated description of cables designed so as to avoid producing a spark if the cable is broken, the spark being considered dangerous in mines containing fire-damp. In one of these the inside wire, which is the safety conductor, is of steel or bronze, surrounded by an insulating material, then surrounded by the main conductor of stranded copper wires; when stranded, the safety conductor will break first, and the independent battery current, which travels through it, will then interrupt the current in the main conductor by means of a switch placed outside of the mine. In another case the safety conductor is in the form of a steel tape wound around the insulated copper conductor in the form of a spiral; when subjected to crushing, as distinguished from tension strain, the two conductors are made of the same metal, but when it is desired to provide against tension, the safety conductor is made of a metal having less ductility. In another form the cable is double, having two main conductors and two safety conductors, all of which are concentric.

Manufacture of Wire. PERRINE. *Elec. Eng.*, February.—A continuation of his serial, the present portion of which is devoted entirely to the subject of drawing or rolling wire.

ELECTRO-PHYSICS AND MAGNETISM.

Roentgen Rays.—The Lond. *Elec.*, Feb. 14, in an editorial, remarks that in connection with the discovery of these rays the name of Cromwell Varley, "the prime discoverer in this great affair," should not be forgotten; much credit is also given to Crookes, reference being made to his famous address on "Electricity in Transitu from Plenum to Vacuum," and his triumphant disproof of Hittorf's and Puluj's objections; attention is also called to Lord Kelvin's Royal Society address in 1893, an abstract of which is published in the same issue of that journal. The same journal publishes brief extracts from a number of papers on this subject in *Comptes Rendus*, Jan. 27 and Feb. 3; in these Le Bon, in an article on dark light, makes public some researches which he has been carrying out for the past two years on photography behind bodies opaque to ordinary light; his experiments prove that ordinary light, or at least certain rays, traverse the most opaque bodies without difficulty; opacity is a phenomenon which exists only for an eye like ours, which, if it were constructed a little differently, could see through a brick wall. A brief description of what he has done is given; it appears that he laid a "photographic cliché" above a sensitive plate covering it with a sheet of iron and exposed the whole to the light of a petroleum lamp for about three hours, after which a very clear but pale image was produced; if the conditions are slightly modified images almost as good as if no obstacle had been interposed will be obtained; when the whole was enclosed in a sort of metallic box, the front of which was iron and the rest lead, a good image was obtained; solar light yields the same results and does not appear to be very much more active; cardboard and metals, especially iron and copper, are easily traversed by light, and the passage of light through the most opaque bodies is only a question of time. In another article by the same author he describes the precautions taken to eliminate the effects of light which has been stored up in the objects previous to the experiments; another experiment showed that heat could not have been the cause of the phenomenon; aluminum, copper and iron sheets of 0.5 to 0.8 mm were used; photographers' black paper in spite of its being so thin, is only slightly transparent to these rays. In an article by Benoist and Hurmuzescu on new properties of these rays, they describe experiments with electroscopes 20 cm from the tube and found that through various laminæ in the window of the metallic cover of the instrument, the rays "immediately and completely discharged the electroscope, though more rapidly in the case of negative charges than in the case of positive." In an article by Nodon, he states that he cannot get any appreciable impression on a bromide of silver plate, exposed for 15 minutes, to a 20-ampere arc at a distance of 40 cm, behind several thicknesses of black paper; he also found that Roentgen rays are not affected by different colored media. Chabaud made experiments with metallic lamina crossed with one of platinum and found that the latter only was quite opaque for an exposure of 45 minutes and a seven-cm spark coil; he also found that mercury 0.1 mm thick was as opaque as platinum, which latter appears to have been 0.01 mm thick. Moreau experimented with the brush discharge of an induction coil; no results were obtained when the discharge was at right angles to the plate, while when parallel to it clear, strong negatives were obtained; an appreciable refraction was found in two cases through wood, as also a decided absorption; the exposures varied from 30 minutes to one hour; no results have so far been obtained with a discharge from an electrostatic machine. A quotation, signed Blythswood, from the current issue of *Nature*, is also given; he used a Wimshurst machine with 128 plates, three feet in diameter, driven by a 1.5-hp motor, and giving a torrent of sparks two feet long; a thick sheet of lead was placed between the poles and connected to the ground, the two poles being insulated; the metallic object to be photographed was also connected to the ground; the plate was perpendicular to the direction of discharge and was placed first on one and then on the other side of the lead screen, good, strong negatives being obtained in either case with exposures of about 20 minutes; a silent brush discharge was used; when the sensitive plate was quite out of line of the discharge, and when parallel to it, equally good results were obtained; he concludes that vacuum tubes are not essential, but adds that he is not sure of this as he used isochromatic plates; he is making further experiments.

The Lond. *Elec. Eng.*, Feb. 14, states that with a Tesla coil, Swinton reduced the exposure for the living hand to 55 seconds; it is stated that a series of short exposures are preferable to a long and continuous one, as the glass becomes very hot and there is danger of destroying the tube, while a succession of short discharges gives the tube time to cool. Mr. Gifford stated that it made no difference whether the rapid or the ordinary photographic plates were used; he also found that fluorescing uranium glass appeared more opaque than common glass. Prof. Whittman, of Budapest, is reported to have succeeded in reducing the time of exposure to three minutes in ordinary cases, and to 30 seconds under very favorable conditions; he connects the mercury pump permanently to the vacuum tube. In Berlin these photographs have been used to distinguish real from imitation pearls; the Vienna War Office has ordered experiments to be carried out in the gun factory for testing the homogeneousness of castings for gun tubes.

The Lond. *Elec. Rev.*, Feb. 14, states that Lannelongue, Barthelemy,

and Oudin have succeeded in settling a disputed point in pathology by photographing a thigh bone attacked with osteomyelitis; the photograph showed the surface of the bone to be intact, while the internal parts are destroyed; this serves to distinguish this disease from periostitis, in which the alterations in the bone precede inward from the surface.

The *Elek. Zeit.*, Feb. 13, contains a very brief communication from the Siemens & Halske laboratory referring to some experiments with the same apparatus that they have used for some years for the generation of ozone by means of the so-called silent discharge and in which a comparatively low voltage of about 10,000 volts is used in connection with rapid and regular alternations; the current is either an intermittent direct current or an alternating current of high frequency; it seems the former is preferable; even with the smallest apparatus several tubes could be operated simultaneously; the exposure when only a single tube is used is not appreciably less than with the usual apparatus; the piercing of the tubes is avoided almost entirely; similar results were also obtained with ordinary incandescent lamps, the filament of which was made one pole and an external electrode of tinfoil being the other. (This seems to be the apparatus referred to in the *Digest* last week.)

New Properties of Cathode Rays. Perrin. Lond. *Elec.*, Feb. 14.—A translation of the article mentioned in the *Digest*, Feb. 22.

High Vacua Research. Lord Kelvin. Lond. *Elec.*, Feb. 14.—An extract of his presidential address to the Royal Society in November, 1893.

Action of Ultra-violet Light on Discharges. Swyngedauw. *L'Ind. Elec.*, Feb. 10.—A reprint of an Academy paper in which he shows the difference of the action on the static and dynamic sparking voltages.

Electricity as a Mode of Motion. Walker. Lond. *Elec. Eng.*, Feb. 14.—A few further remarks regarding his theory. (*Digest*, Feb. 22.)

Electromagnets for Lifting Purposes. Lond. *Elec. Rev.*, Feb. 14.—An illustrated description of the magnet designed by Holden, which has been in every-day use at the Woolwich arsenal for the last four years for the special purpose of lifting cylindrical shot; the magnet is shaped like an inverted U, being very short and having a single coil around the neutral part, the poles being curved to fit the shot; duplicate twin wires are used for leads to prevent accidents in case of the wire breaking; the current varies from three to four amperes at 20 to 30 volts; the weight of the magnet is 45 pounds and the maximum weight lifted exceeds 3600 pounds, which is twice the weight of the heaviest shot.

An Arc Phenomenon. Freedman. *Elec. Power*, February.—While experimenting with the arc he noticed a peculiar phenomenon; while maintaining an arc between brass electrodes and gradually reducing the current, he finds that there is a certain critical point at which the nature of the arc changes and appears to become like the discharge of a Holtz machine whose condensers have been disconnected; the light becomes a deep violet in color, the current falls to about one third and the voltage rises to about three times its former value; if the distance is delicately adjusted these changes take place back and forth as though there were a point at which the phenomenon was in unstable equilibrium; when the discharge is no longer a true arc the negative electrode becomes intensely heated; with brass or copper electrodes ⅛ in. in diameter the critical point was obtained, when the voltmeter read 350 and the ampere-meter 0.06, the distance being very small; when there was a true arc the current was 0.2 and the voltage about 100; the negative electrode became red hot for about half an inch, ozone was liberated in large quantities and it seemed as if the arc changed to a regular gas discharge; he thinks the heating of the negative electrode is due to one of the properties of cathode rays; he hopes soon to present some more accurate and complete data.

Discharges Investigated by Means of Stereoscopic Photography. Himes. *Photographic Times*, February; reprint in the *Elec. Eng.*, Feb. 26.—When a succession of sparks is photographed in the ordinary way they simply form a bundle of very weak and confused lines, but when the photographs are seen through a stereoscope the confused mass of lines resolves itself into distinct and separate lines, each with its peculiar shape and its true position; by varying the conditions under which the sparks are produced the effect on the shape, position and general character of the spark can thus be studied; a few illustrations, which must be examined with the stereoscope, are reproduced.

Roentgen Rays. The *Eng. & Min. Jour.*, Feb. 15, states that Mr. Edison has found a new application of these rays for the tempering of various metals; he has arrived at astonishing results with aluminum, hardening and tempering it to such an extent that it was scarcely recognizable; no further information is given.

The *West. El.*, Feb. 29, contains an article by Prof. Stine describing his experiments. The same journal publishes brief descriptions of other experiments and extracts from papers, containing, however, nothing of special importance.

New Experiments with Cathode Rays. Perrin. *Elec. Eng.*, Feb. 26.—A translation of the article referred to above.

Vacuum-Tube Illumination. Moore system. *Sc. Amer.*, Feb. 29.—An illustrated description of the Moore system, which has been described in these columns.

Electrodynamic Rotations Produced by Alternating Currents. Ferraris. *West El.*, Feb. 29.—A reprint of the translation of this paper, which was abstracted in the *Digest*, Jan. 18.

ELECTRO-CHEMISTRY AND BATTERIES.

Primary Battery. Heil. *Electrochem. Zeit.*, February.—An article on depolarized batteries, in which he gives a brief review of the subject, and a description of a battery recently patented to him, which gives a very constant current, and has an exceptionally great output; with a cell, for instance, having an electrode of the size of a five-cent piece, he ran an electric bell four hours uninterruptedly. The cell consists of a glass vessel filled with chloride of ammonium solution, the anode being amalgamated zinc, and the cathode sulphide of silver; the latter is prepared as follows: A silver foil, which is alloyed with copper, is covered while hot with sulphur; when the heating is continued the sulphur will burn off, part of it combining with the silver; this process is repeated a number of times until the layer of sulphide of silver is sufficiently deep or until the whole plate has been converted into that compound; the sulphide of silver and copper thus obtained is melted to a strip of silver forming the terminal; when such a plate is used for the first time in the cell very little current will be produced, but this will increase gradually, the voltage being 0.7; the capacity is very high, as an electrode of 10 sq. cm and 2 to 3 mm thick will give one ampere-hour; on open circuits there is no consumption, provided the zinc is well amalgamated; the current is greatly increased if the cell is first discharged, during which hydrogen sulphide gas will be given off and a precipitate formed, the electrode being then washed and dried in the air; after this the voltage will be 1.1 and the current six times as great; after the second discharge the electrode may again be dried in the air, when it will be ready for another discharge; by this process the electrode will become very porous, and in drying in the air the finely divided copper which permeated the whole mass will be oxidized; while it is generating current metallic copper is set free throughout the plate; it can be used as a secondary battery.

End Plates in Accumulators. Langelaan. *Electrochem. Zeit.*, February.—He calls attention to the end plates in an accumulator, which are generally made like the others and therefore have twice the necessary surface and capacity, which diminishes the internal resistance so that the plates next to them discharge more than they should, thus producing buckling. He therefore suggests making these end plates so that they have half the surface and half the capacity, and accomplishes this with the ordinary grid plates by punching the active material out of every alternate mesh, leaving half the meshes open and the other half full.

Blot Accumulator. Lond. *Elec. Rev.*, Feb. 14.—An illustrated description of this accumulator, a notice of which, taken from the French, was given in the *Digest*, Dec. 28; see also Feb. 15.

Pure Aluminum. Electrochem. Zeit., February.—Roger, in Paris, produces pure aluminum by an electrolytic process, with a small expenditure of power; the bottom of a non-conducting vessel contains mercury which forms the anode, while the cathode is carbon containing the mineral bauxite; the liquid seems to be sodium hydrate, which forms a basic solution of aluminum oxide with the bauxite; on passing the current the metallic aluminum is deposited in the mercury, forming an amalgam, while the metallic sodium set free forms with the bauxite cathode a solution which replenishes the bath (the description of this part is either incorrect or not clear); the aluminum is obtained from the mercury by distillation; no further information is given.

Electro-Chemistry in 1895. Weyer. *Electrochem. Zeit.*, February.—The conclusion of his article (*Digest*, Jan. 25).

Indicated Evolution in the Storage Battery. Paget. *El'ty*, Feb. 26.—He claims that recent discussions on the storage battery have been very irritating to those who have been doing real work in discovering, or trying to discover, the weaknesses of the present developments, because of the annoying assumption that the batteries as at present developed "had reached the condition of its human creator." It appears to be tacitly accepted as an inherent defect that the capacity must be dependent on its rate of discharge, which he considers characteristic of only one form of battery under certain conditions, "but not necessarily of all, nor in fact of any"; he claims that no reason has been given why this characteristic should be considered inevitable. Regarding the density of the electrolyte, he shows that it has been gradually increased; the lowest electrical resistence is when the density is 1.250, and he therefore made experiments (which have been frequently made before) with a higher density, in order that the resistance should diminish as the voltage falls, so as to make the discharge voltage as nearly continuous as possible; he thinks a plate will be produced which will be able to withstand such concentrated acid. He shows the importance of the time factor, aside from that required for chemical action, which is appreciable, but which enters in so far that there is a prevention of chemical action by the omission to provide proper convection of the solution at the working surfaces; this convection-time is, therefore, a very important factor. So-called sulphating, he claims, has now nearly disappeared; he believes it to be due to imperfect contact "in now obsolete forms of plates, between the active material and its metallic support"; with the old form of Planté plate it was unknown. He suggests that progress may be made "in maintaining during discharge the resistance of the acid solution longer at a minimum point by the addition of other ingredients to the electrolyte." The state-

ment that separators "restricted the electrolytic path" has no foundation in fact, although with some forms he admits that there may be considerable increased resistance; the so-called solid electrolytes tend to increase the convection-time rather than the internal resistance, and there is, therefore, not a proper supply of active electrolytes to the working surfaces. The article is to be continued.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Standard Resistances. FEUSSNER and LINDECK. Lond. *Elec.*, Feb. 14; a translation of a contribution from the Reichsanstalt, the original of which appeared in the *Zeit. f. Instrumentenkunde*, November and December, 1895.—He gives a well-illustrated description of the wire standards used by that institution, and adopted by them after long researches; that institution has constructed a series of resistances ranging from 0.0001 ohm to 10,000 ohms; only those of 0.1 and upward are considered in the present paper, and are constructed of wire. The coil is immersed in paraffin oil hanging by the two heavy copper leads from mercury cups, and swinging freely in the bath, the oil having free entrance on all sides; the wire is made of manganin wound on a brass cylinder in a single bifilar layer for the one-ohm coil; for the 0.1-ohm coil a second wire having 0.1 times the section and 10 times the length is joined in parallel with this, and is for the purpose of making the adjustment more accurately and readily, an alteration of one metre in the length of this shunt being equivalent to 1 mm in the main wire; the wire is silver soldered to washers, which are secured and soft-soldered to the terminals; this has been found preferable to soft-soldering the wire directly to the copper leads; the wire is covered with shellac and heated for 10 hours to a temperature of 140° C., which protects it from subsequent oxidation besides holding the wire fast to the bobbin; heating also eliminates the alteration of the specific resistance with time; two or more wires in parallel should be used in preference to a thick wire, and the apparatus is so designed as to be capable of dissipating a large amount of heat; a formula for the heat dissipated is given; the best liquid is petroleum. A number of tests made with these coils are described and the results given; among other things it was found that a constant temperature for large currents is reached in about one minute, while for smaller amounts of heat, especially when they are in air, a much greater time, up to one hour, is required; the advantages of the perforated case are also pointed out; the standard paraffin bath (although in another place they state that the best liquid is petroleum) was found to be capable of dissipating a large amount of heat; it was found that for commercial standards 100 watts may be allowed; a table of the highest permissible currents is given, the one-ohm coil for instance being capable of carrying 10 amperes when used as a commercial standard and one ampere when used as a precision standard. The methods for comparing the standard resistances are described; the Thomson modification of the Wheatstone bridge for comparing standards of the same value is apparently preferred, and it is stated that they can be quickly and accurately compared to a few millionths of their value. The constancy of these coils is discussed and results are given which show that manganin is very suitable for wire resistances in practical use; less experience was had with constantan, but it is thought to be equally good in this respect. The article is discussed editorially.

Vibration Galvanometer. Elek. Zeit., Feb. 13.—A description, without an illustration, of the instrument which was referred to briefly in the *Digest*, Nov. 2 and 9; it is intended in general for measuring very weak alternating currents.

Standards of Light. DIBDIN. Lond. *Elec. Eng.*, Feb. 14.—The conclusion of his paper (*Digest*, last week); it includes a description of the Dibdin 10-candle standard as recommended by the committee for use in gas testing in London; there is no illustration; it is followed by a report of the discussion of the paper.

Instruments. Lond. *Elec. Eng.*—The long series of specially contributed lectures given at the City and Guilds of London Institute, is being continued in this journal; the issue of Feb. 14 describes and discusses hot wire instruments.

Designs of Condensers. HAROLD SMITH. *Elec. Power*, February.—He gives some formulas for the calculation of plate condensers, adding a table showing the calculated and observed capacities of different condensers.

Standards of Light. DIBDIN. *Prog. Age*, Feb. 15.—The beginning of a reprint in full of the paper mentioned above.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Distribution of Currents Through the Earth's Surface. STRECKER. *Elek. Zeit.*, Feb. 13.—A communication from the government telegraph department describing briefly some researches made during the past year to determine the distribution through the earth's surface of strong currents led through part of the earth, apparently with the object of finding the laws governing the conditions and distances for such systems of telegraphing without wires. The primary current is passed through the earth between two earth plates connected by an overhead wire, and having in the circuit an interrupter and a key; the two earth plates for the distant secondary circuit are also connected with each other by a wire and contain a telephone. Among the conclusions reached are that for the primary source an alternating-current machine is preferable, for with the same expenditure of energy it gives three times the effect that an interrupted direct current will give; a formula is given for the distance to which telegraphy is possible through the earth; it appears that this distance is proportional to the primary current, and the product of the distances between the earth plates in each of the circuits, and inversely proportional to the resistance of the secondary, the whole being multiplied by a constant which differs under different conditions, being three times greater for alternating than for direct currents and considerably greater for water than for earth; but this formula cannot be applied in general, as it is limited to the specific conditions under which the tests were made.

Cable Defence Scheme. Lond. *Elec. Rev.*, Feb. 14; an editorial discussion of the suggestions of Mr. Snell (*Digest*, last week).—A speed of 30 knots an hour is nearly three times that at which a telegram cable has ever been paid out; some errors are pointed out and disagreement is expressed with the methods of procedure which were suggested; it may be difficult though by no means impossible to pay out a cable at such a speed, but the method suggested by him for doing so are not recommended by that journal; it is thought possible that the cable would pay itself out better without any machinery whatsoever.

Military Telephone. Lond. *Elec. Rev.*, Feb. 14.—A translation with illustrations of the article abstracted in the *Digest* last week.

Electricity in the Management of Railways. DUMONT and BAIGUERES. *Mem. Soc. Ing. Civ.*, November.—A very long article amounting to a short treatise on the subject; they discuss the uses of electricity for telegraphy, telephony, signals and controllers in the operation of railways, and with a brief reference also to electric motors used for turntables and similar purposes.

The Telephoning of Railways. PIGG. Lond. *Elec. Eng.*, Feb. 14.—He discusses the use of the telephone in place of the telegraph in connection with the management of large central railway stations.

Telegraphy in Japan. Elec. Friend (Japan), January.—The survey and preparations for the new Formosa cable from Kagoshima, Japan, have been completed; the distance is about 900 nautical miles, the total estimated cost is $2,000,000, and the cable is to be laid in May to August. The government is asking for half a million dollars to improve and increase the telegraph service. For the year ending May, 1894, the total number of messages in Japan was 8,359,139, an increase of 27 per cent. over that of the previous year; the gross income was about $1,500,000, an increase of 55 per cent. The government is asking for $6,400,000 to change the single-wire telephone system of four cities to a double-wire system, and to open 36 new exchanges.

The Telephone Question. PENNETT. Lond. *Elec. Rev.* and *Elec. Eng.*, Feb. 14.—A reprint of a paper which appears to be chiefly of local interest; it is also discussed editorially.

Electric Clocks. REVERSHON. *Cosmos*, Feb. 16.—Beginning of a descriptive article on the present electric clocks.

Practical Automatic Telephone Exchange System. MUNNS and DELAND. *Elec. Eng'ing*, February.—A well-illustrated description of a system.

MISCELLANEOUS.

Electric Fish. D'ARSONVAL. Lond. *Elec. Eng.*, Feb. 14. A brief abstract of a recent communication to the French Physical Society.—He found that the curve of the discharge is very similar to that of the contraction of a muscle, but it contains indentations showing that there are really several discharges, usually about 18, with a total duration of 0.1 to 0.15 second; on open circuit a voltage of over 300 was observed, but the effective voltage is much lower; the analogy between the cells of the electric organ and the elements of a voltaic pile is only apparent; no effect is obtained without a muscular attraction and he considers that the cause must be sought for in a variation of the contact surfaces of the cells of the organ.

Abstracts. Jour. Inst. Elec. Eng., February.—A number of abstracts from French papers of articles, all of which were noticed more briefly in the *Digest*.

Carbide of Calcium and Acetylene. HOSPITALIER. *Bul. Soc. Int.*, January.—A reprint of his paper; *Digest*, Feb. 22.

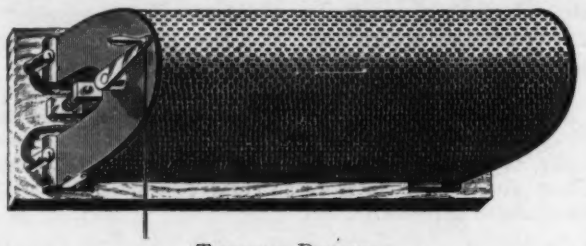
Alternating-Current Clock. Elek. Zeit., Jan. 30.—A brief, illustrated description of the clocks used in connection with the Cologne station, which are driven by the alternating currents from that station; they consist simply of a synchronous motor having a bare, star-shaped armature, and a bipolar field magnet; it drives the hands by means of a double worm wheel reduction; the clocks must all move in synchronism with the clock at the central station, the time of which is regulated by comparison with a master clock; should small differences arise they are corrected by slightly varying the speed of the alternators for a moment. Each clock consumes about seven watts; the motors are started by giving the armature a rapid turn with the hand, which, with a little practice, is said to be a very simple matter.

Electrical Effects of Spray. Pop. Sc. Mo., February.—A correspondent states that he believes the deficiency of ozone and other unfavorable conditions, as also the effect of atmospheric impurities, may be alleviated by inhalation through a spray of cold water; an effective method of ventilating railway cars depended on this principle; Lenard made

observations with waterfalls in Switzerland, and found that even small cataracts send into the air considerable charges of electricity provided a large amount of water dashes down rapidly; he suggests that the chief cause of electrification is the tearing asunder of the drops as they fall at the bottom of the waterfalls; the experiments agreed with demonstrations of Lord Kelvin; this source of electrification is by no means insignificant, and the amount of electricity sent in the air in this way is said to be immense.

Theatre Dimmer.

The accompanying illustration shows a theatre dimmer made by the Washington Electric Company, 197 South Canal Street, Chicago, Ill., which embodies some sterling features. Contact is made on the resistance wires direct, thus obviating the weakness inherent to numerous soldered connections, and insuring the gradual reduction of light without any accompanying blinks, so necessary for proper scenic effects. All of the resistance is disposed in a single coil of bare wire wound tightly over

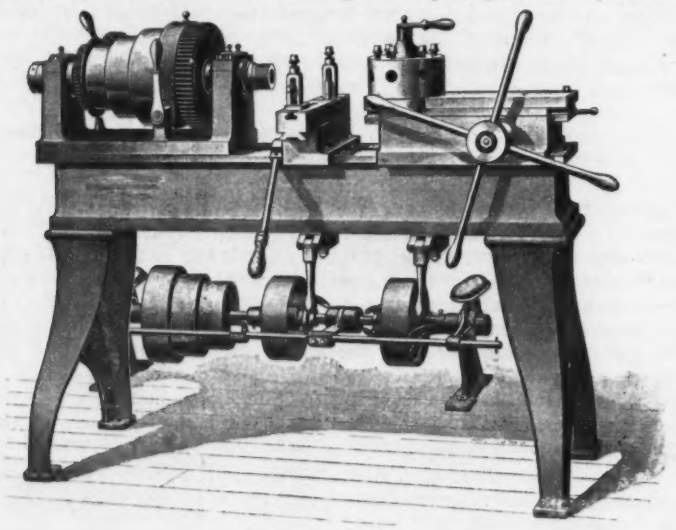


Theatre Dimmer.

an asbestos-covered cylinder. The regulating mechanism is so arranged that one quarter turn of a crank or wheel moves the coil from zero to full resistance, and permitting 250 graduations of resistance within that limit of motion. The illustration shows the dimmer as mounted out of ordinary reach, a connection in this case leading to within reach of the hand for manipulation. The total resistance of the model shown is 10 ohms, and it is adopted for the regulation of 30 16-cp, 110-volt lamps.

New Monitor Lathe.

The accompanying illustration shows the general design of a new 14 and 16-inch monitor lathe made by the Davis & Egan Machine Tool Company, of Cincinnati, O. These tools are used extensively in the manufacture of brass and other metal goods requiring several operations



Monitor Lathe.

for their completion. The head stocks are of effective design, having large cones for wide belts. The spindles are of hammered crucible steel and run in bronze bearings, with provisions for taking up the wear. These lathes are furnished with either plain or friction heads. The friction head, as shown in the cut, is operated by a handle in front, and enables the operator to secure two speeds without stopping the machine. This is found very convenient for boring and tapping.

The turrets have six holes to receive the various tools and revolve automatically. The bottom slide is provided with a taper gib at its base to maintain perfect alignment of the holes with the main spindle. Adjustable tapers also are fitted to the sides of the top slide, furnishing a means for lateral adjustment. At the base of the turrets is a hardened steel index ring of large diameter; the locking bolts are also hardened, square in section and provided with a taper gib for adjusting screw. A spiral spring, the tension of which can be regulated, forces the locking bolts in the slots. The cutting-off rests have a wide bearing on the bed, and are operated by a lever. The height of the tools is adjusted by a parallel wedge, resting on a square collar to give extra stiffness. These lathes are also furnished with power feed to the turrets, Parkhurst automatic chucks, chasing bars forming rests, and friction heads if desired.

Baldwin-Westinghouse Electric Locomotive.

We give herewith several illustrations of the 1000-hp size of the series of electric locomotives which the Baldwin-Westinghouse combination have arranged for standards. The sizes range from 100 to 1600 horse-power, and are for different purposes, the smaller sizes being intended for mines and light tramways, and the larger for tunnels.

The principal feature of the new system of construction is the use of geared motors. This permits the construction of locomotives that are easy to repair, reasonable in cost and simple in construction. The superstructure of the electric locomotives, on account of the character of its motive machinery, may be made in any form, but it has been found upon investigation and inquiry among railways, that they would prefer the superstructure to be made ample in size to receive railroad freight; that is, freight belonging to the road itself, which is often shipped from one point to another on the road, and to receive baggage, mail and wrecking apparatus, replacing frogs, chains and jack screws, crowbars, etc.

The large superstructure which has been asked for by the railway companies has been provided for this reason among others. For freight engines, a lookout is placed on top, so that the conductor can see back over the train, and bunks are provided for trainmen instead of in the caboose, and there is ample room to provide racks for such tools as are always carried somewhere on any important train.

The power of this locomotive to travel at high speed is somewhat greater than that of the standard engines of the Pennsylvania Railway which haul the limited trains. When moving at a freight train speed, it will haul more than the heaviest consolidation engines of the Pennsylvania road. A large steam locomotive can often generate a thousand horse-power for 15 or 20 minutes, and then time must be provided for cleaning the fires. In the case of the electric locomotive 1000 horse-power can be developed indefinitely, as it is only dependent upon the central station.

The speed of the electric locomotive is dependent upon the gearing. By making the reduction of the gearing suitable, the speed may be made almost anything. This locomotive, with a gearing of ½ to 1, is perfectly adapted to run from 70 to 100 miles an hour, and with a gearing of 4 to 1, is adapted to pull heavy loads at a freight train speed. It is not necessary to change the size of the driving-wheels, for the reason that all parts are perfectly balanced, and they can run smoothly at almost any speed at which it is safe to drive a locomotive. These wheels are 42 inches in diameter, and are larger than are used on Pullman cars.

The locomotive is about 38 feet over the pilots, about 9 feet 6 inches wide and 13 feet 6 inches high. The weight in working order is 150,000 pounds. There are four axles, all of which are driven by electric motors. In the case of a steam locomotive of the ordinary type there are four axles on the tender, two axles on the truck and two driving axles or eight axles, only two of which are driven. The total weight of the steam locomotive, including its tender, is about 200,000 pounds, of which about 70,000 pounds, which is on the driving wheels, is available for

Fig. 1.—Baldwin-Westinghouse Electric Locomotive.

adhesion, or only about 35 per cent. In the case of the electric locomotive, the whole weight, or 100 per cent., is useful, so that this locomotive, weighing 150,000 pounds total, has about twice as much hauling capacity as the 200,000 pound steam locomotive.

It is interesting to see that electric locomotives of the new Baldwin-Westinghouse type, when constructed with all the essential parts for driving the machine and for the convenience of the train men, do not weigh as much as is necessary to give them the proper adhesion. In the case of this locomotive, the weight of all the essential parts is but about 100,000 pounds, and in order to get the necessary weight to keep the drivers from slipping, cast-iron floor plates are put on about five inches thick; in other words, about 25 tons of cast-iron has to be added. Gearless locomotives are so much heavier that the essential parts weigh enough to give the necessary adhesion; but as these essential parts are made of expensive material, such locomotives cost a great deal more.

Switching locomotives are made exactly the same in the underneath part, but differ in the superstructure. There is a cab either in the centre or at the end, the cab being much shorter than the locomotive. In case the cab is at one end, an electric crane is put on the other end, so that each switcher becomes a wrecking locomotive or traveling crane, and it

is expected that the income that can be derived from having traveling cranes that can be used as switchers, would be more than sufficient to pay the extra cost of the crane work.

The mine locomotives are quite different in construction. They are generally made with six drivers connected in a rigid frame, and surrounded by a light sheet-iron cab. The rack locomotives are designed to climb grades up to 45 per cent., such as is used on the Pike's Peak railway, where the gear or rack is laid between the rails, and the locomotive climbs by means of the spur gear, which is driven by electric motors and fits in the rack.

These locomotives may be run on any system, whether the two-phase, the electromagnetic or button system, the overhead trolley or third rail. They can be used either with the plain direct current or the alternating current, or the multi-phase. The Westinghouse Company considers that the best method for operating tunnels and yards, or in any case where there is a heavy current, is the electromagnetic or button system, and all these standard locomotives will be fitted to run with that system. These 1000-hp locomotives will have the apparatus provided also to

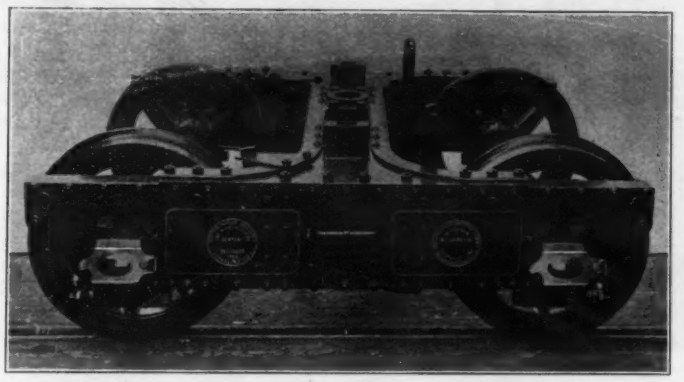


FIG 2.—SIDE VIEW OF TRUCK.

run by an overhead trolley, and for this purpose a considerable section of the Turtle Creek railway is now being fitted with overhead wires for the trolley system and with the buttons for the electromagnetic traction system. The length of the equipped line will be about a mile and a half.

Within a short time, a motor car suitable for elevated railways and suburban lines will be received at East Pittsburg from the Baldwin Locomotive Works, and will be equipped to run both on the two-phase system and with the direct current. This motor car will have seats in the interior for passengers similar to those used on the Manhattan Elevated Railway, and will in every way be equipped for service on the Manhattan road.

There is also in course of construction a special electric locomotive for use with the multiphase alternating system. It will be used for exhibit and experiment at East Pittsburg. This equipment is simply the experimental equipment to be used at the Westinghouse Electric & Manufacturing Company's works at East Pittsburg, on the Turtle Creek branch of the Pennsylvania Railway.

In addition to these locomotives, the Baldwin-Westinghouse combination are constructing electric locomotives for other purposes at Philadelphia. One of the most interesting is a heavy 200-hp mine locomotive for West Virginia.

All of the rheostats, switches and wiring that were formerly placed under the car and out of sight on electric locomotives, are, in this class of

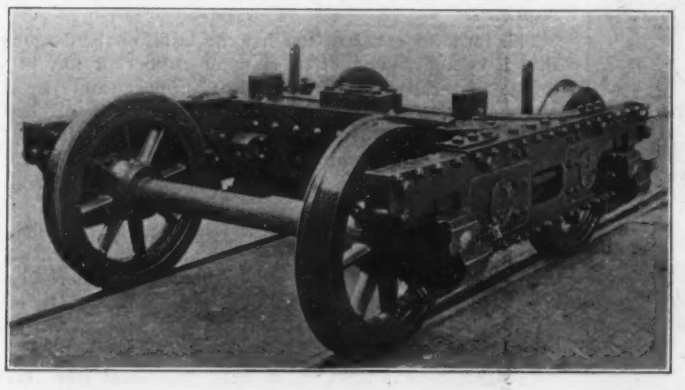


FIG. 3.—END VIEW OF TRUCK.

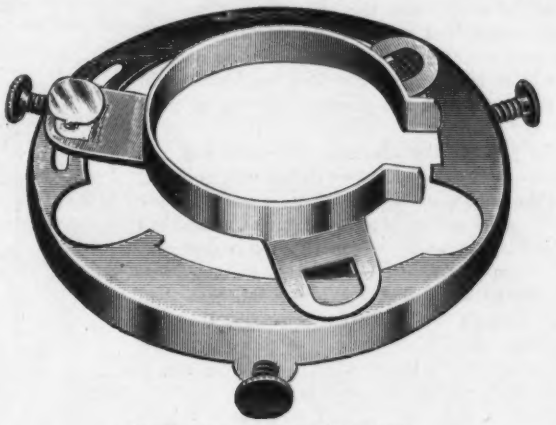
apparatus, put above the floor, where they can be readily reached and examined. Instead of having about 100 wires going through the floor and fastened along the sills in exposed positions, there are in this locomotive only four cables, which are protected by a lead covering. All of the wires that ordinarily form a net-work under the floor are now placed above the floor, in a case which holds not only the rheostats, but forms the controller itself.

On a steam locomotive an engineer has to operate about twenty handles, keep watch of the fireman, the height of the water in the boiler, the steam pressure, besides looking on ahead; while on this electric locomotive there are but three handles: the reversing switch, the controller and the air-brake handle, so that the attention of the engineer can be confined to the track ahead.

The air-brakes are operated in the usual way, by a pump which is driven by an electric motor. The machine is practically noiseless, and is placed under the floor of the locomotive. The head-lights are illuminated either by electricity or oil.

A New Shade Holder.

The shade holder we illustrate, made by the Housatonic Manufacturing Company, Wallingford, Conn., has the decided advantage of always maintaining a shade absolutely concentric to an incandescent lamp, notwithstanding the type of socket with which it is used. Still a further advantage, and one that will be appreciated by the wireman, is that it is



CONCENTRIC SHADE HOLDER.

very readily and easily secured to a socket, it being merely necessary to give a few turns to a thumb screw.

The holder consists of two distinct parts, a ring for holding the shade and another part for securing to the socket. The latter has clips which clasp the horizontal part of the shade portion; when the holder is fitted to a socket the socket ring is turned, which causes it to close in and firmly grasp the socket, when it is secured by the thumb screw shown. As the ring is turned it remains, on account of the shape of the guides in the shade holder position, always concentric, whether the socket shell is of large or small diameter. The holder will fit equally well all sizes of sockets, and can be applied in a fraction of the time necessary for the ordinary screw socket.

A New Porcelain Rosette.

The rosette we illustrate, manufactured by the Chapin-Douglass Electric Company, 136 Liberty Street, New York, differs from others now on

PORCELAIN ROSETTE.

the market in several respects. The cap is held in position by the yielding arm *Y*, which rests the shoulder *S* secured to a projecting lug of the base. The yielding arm pressing against the face of this projecting piece secures a firm contact; it will be noticed that the cap is held in place independently of the contact. The adjustment is simple and easily effected. To facilitate fusing, the fuse lugs are located a convenient distance from the edges of the cap.

Ironclad Arc Dynamos.

Realizing the advantages of the ironclad armature, which has almost completely replaced the surface-wound type in constant-potential work, the Western Electric Company has designed a complete line of arc machines having iron-clad armatures and other new features. These armatures have been in use in increasing numbers for over a year without the loss of a single coil—a point that will be appreciated by practical men. This is a sufficient demonstration of the possibility of insulating an ironclad armature for high voltages, and once having accomplished that task, the mechanical superiority of the ironclad armature is unquestionable. The general features of this dynamo are so plainly shown in Fig. 1 that description of these is unnecessary.

The bearing bracket is bored out at the same time the pole-pieces are bored. The bearing can thus be turned around the shaft until the foot is clear of its seat, when the armature will rest in the pole-pieces, and the bearing can be slid off with a very slight exertion. The bearing may be removed in about five minutes, the pulley in three minutes, and the commutator in 10 minutes.

On the yoke of the machine shown in Fig. 1 is mounted a pair of reducing switches which cut out part of the field winding. The lower switch is for the purpose of adjusting the spark at the brushes to the conditions under which the dynamo is running. When this switch is open the machine will run along without flashing under normal conditions, though the spark is in this way reduced practically to nothing. If there are sudden and great changes of load, it is desirable to have the machine run with a slightly longer spark, so that it will not flash before the regulator has a chance to compensate for the change in the load; this can be accomplished by simply closing the switch, which results, of course, in weakening the field and allowing the spark at the brush to lengthen.

The other reducing switch is for the purpose of reducing the current

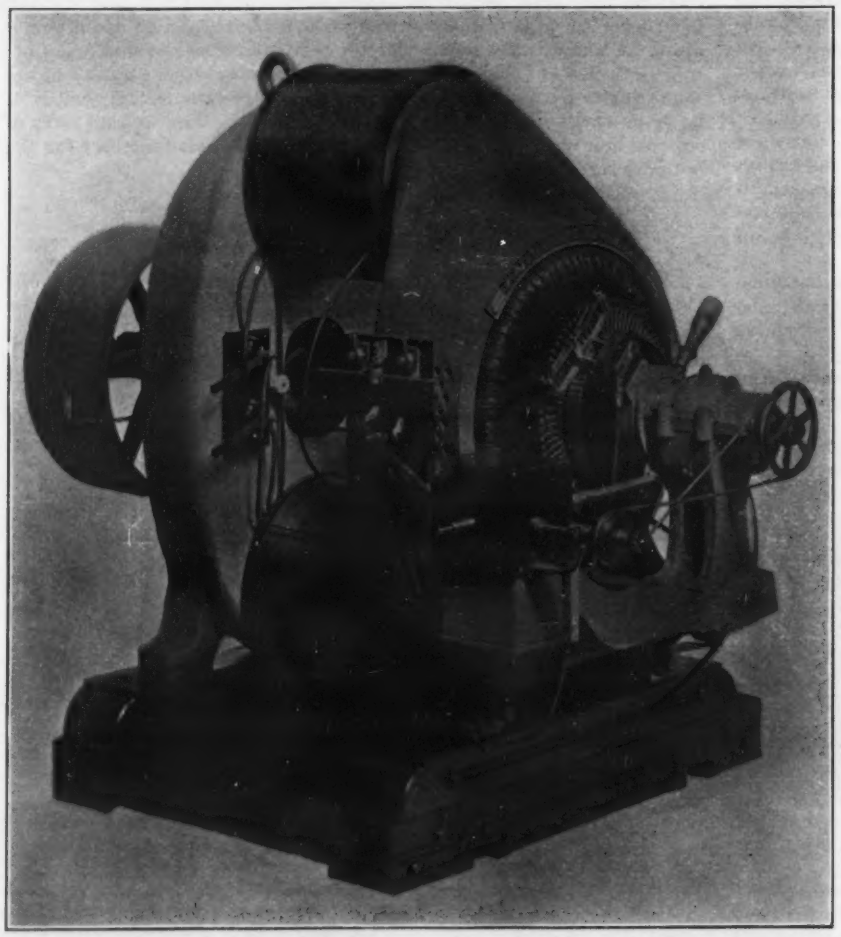


FIG. 1.—IRONCLAD ARC DYNAMO.

output of the dynamo so that if it is desired to run the machine part of the time at a lower current from 9.6 amperes this switch can be closed and the regulator adjusted to the lower current. In this way considerable fuel can be saved when it is not necessary to run the lights at full brilliancy.

The commutator, which is shown in detail in Fig. 2 and complete in Fig. 6, is built up on a very substantial disc of hardwood veneering which is mounted on a brass flange. This wooden disc is then faced with mica and each segment is screwed to it independently of the others. The segments are tapered slightly towards the inside, allowing slate wedges to

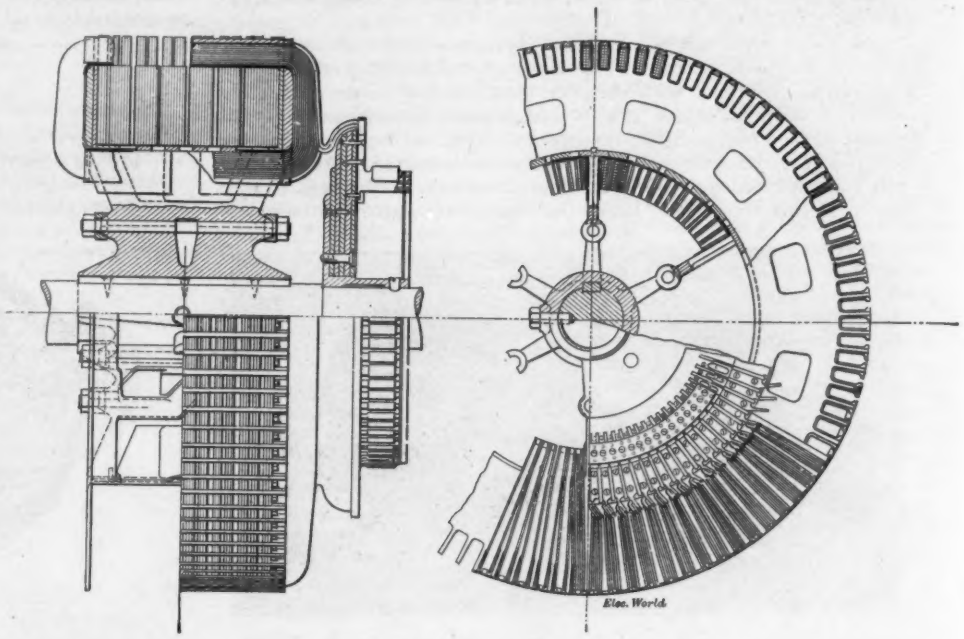


FIG. 2.—DETAILS OF ARMATURE AND COMMUTATOR.

be driven in between them, thereby protecting the mica facing from the action of any burning that might be caused by the flashing of the dynamos.

The outside ends of the segments are held rigidly by a compound ring of mica and veneering, and each segment is held in position on this ring by a machine screw and two dowel pins. The segments are insulated from each other by air spaces, allowing both sides of each segment to be perfectly inspected and cleaned at any time when the machine is running.

With an air-insulated commutator the burning effect of flashing and short circuits is confined almost entirely to the brushes, so that it is not necessary to turn down the commutator after bad flashing, as is the case with solid built commutators. The carbon brushes feed down and compensate for the burning as soon as it is over. All parts of the commutator which are connected with the circuit of the machine, are on the face of the wooden disc, so that there are no parts behind the commutator which have to be cleaned to keep the insulation from running down; all screws used in its construction are also accessible from the front. The segments are increased in size at the working part, so as to provide for a long life and also to hold the flashing as much as possible in the working part of the segments.

This form of construction has the additional advantage that it is not dependent on slate or rubber or any other brittle material for its mechanical support, and yet the mechanically substantial insulation is thoroughly protected by the slate wedges from the burning action of flashing.

The brushes are arranged to cover the commutator over the entire angle spanned by them, and whatever sparking occurs, is concentrated at the tip of the brush. At the brush tip is provided a small independent brush which is automically fed down to compensate for the increased wear due to the sparking at this point. This independent brush is so narrow that the brush angle remains practically constant, no matter how fast the brush may be worn away by sparking.

The armature is built up of very thin sheet iron rings, mounted on a brass spider. The sheet iron rings have teeth similar to those in the standard incandescent ironclad armature; the coils are wound in the slots between the teeth, and are firmly held in place by wooden wedges which are driven in over the top of the winding. The armatures are divided into a very large number of coils of comparatively few turns of wire. In this way the voltage in the individual coils is reduced to such a small amount that there is very little strain on the insulation

between coils and the voltage between segments of the commutator is so low that it is difficult to flash the machines under ordinary running conditions, while, if flashing does occur, the effect on the commutator is scarcely noticeable. By dividing the winding into a large number of small ventilated coils the accumulation of heat in the centre of the coils is avoided, thereby preventing the slow roasting of the insulation which occurs in some machines. The advantage of this form of construction is at once evident in case repairs become necessary, as any coil can be rewound without affecting the others in any way, and as there are no bands, all that has to be done is to slip the armature far enough out of the pole-pieces to work on it, and then take off the commutator and rewind a coil and put the armature and commutator in place again.

In case one or even four or five coils of an armature become injured, it is not necessary to rewind them at once, for if a coil is not short-circuited internally, the terminals of the coil can be simply disconnected from the clamp on the commutator and a small jumper put across the same segments to which the coil was previously connected, and the machine can be run with no serious increase of sparking.

If any of the injured coils are short-circuited internally, of course the short circuit must be gotten out, or the whole coil may be cut out with a solid chisel. If this is done, it is necessary to take out the opposite coil also, in order to keep the armature in running balance. A wooden wedge inserted in the place of the inner portion of the coil will serve to hold the other coils in place.

The following table shows the result of a test made on an 80-light machine, in which armature coils were cut out at various points :

Number coils cut out.	Volts.	Amperes without the use of reducing switches.	Length of spark, inch.	Location of coils.
2	4300	10.4	¼	Adjacent.
3	4250	11.4	⅛	"
4	4200	12	¾	"
8	4000	11.4	¼	Bunches of two.
12	3800	12.2	⅜	Bunches of three.
16	3600	10.4	¼	Four bunches of two and eight single coils distributed around the armature.
16	3600	13.2	¾	Bunches of four.

The spark is somewhat increased in length, but is not of a nature to damage the commutator. The current may be reduced from that shown in the table to the normal amount, by the use of the reducing switches, without materially affecting the length of spark, as will be seen from the following test :

A five hours' run was made, with sixteen coils cut out in four bunches of two, and the other eight unequally distributed about the armature. The current was ten amperes and gave a quarter-inch spark. At the end of the run there was no sign of undue heating, and the commutator was not injured in the least.

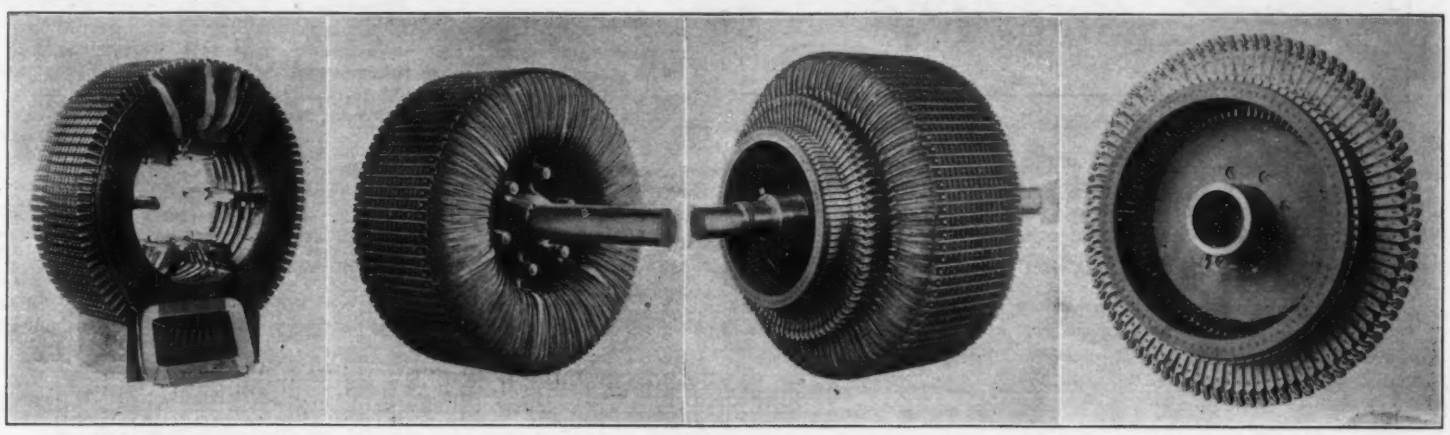
The all-important factor producing long life in an armature, after good insulation has been secured, is that of ventilation. The success of the system of ventilation adopted is shown by a test in which two armatures were built just alike except that one was wound in the usual way, and in the other the coils were ventilated as shown in the cuts and described below. The former heated 80 degrees Fahr. above the air after a 12 hours' run, while the latter only heated 60 degrees Fahr. after a 24-hour run.

The special feature of this system of ventilation and insulation is that the entire ventilating space in the armature may be filled up with carbon or copper dust, leaving the insulation of the machine as strong to resist the breaking down strain, due to the voltage, as it was before, for the reason that each coil is insulated independently of the rest in a trough which completely protects it. It may be remarked here that the time occupied by one man and helper in winding an armature coil is, on the average, 50 minutes for an 80-light machine, which is about an average size.

In some of the older forms of carbon brush-holders used on air-insulated commutators, considerable annoyance was experienced from the noise caused by the chattering of the brushes. This has been almost entirely obviated by the construction adopted. In these brush-holders the main brushes cover several segments at once, and all the brushes are urged by springs in the direction in which the commutator rotates, so there is no chance for the brushes to vibrate. With these brushes it is not necessary to oil the commutator.

The operation of the machines is fully equal to that of the old surface-wound type. The lamps can be thrown on or off in groups equal to 10 per cent. of the capacity of the machine from full load down to short circuit, or *vice versa*, and the regulator will compensate for the changes without flashing the machine. Or the whole load may be thrown on or off instantly, and the regulator will compensate for the change in a few seconds.

The Western Electric Company manufacture this type of dynamo for 50, 60, 80, 100 and 125-light capacity, and is also prepared to furnish these sizes for direct connection to standard high-speed engines.



FIGS. 3, 4, 5 AND 6.—ARMATURE OF IRONCLAD ARC MACHINE.

Portable Electric Propeller for Boats.

The ingenious method of electric propulsion which we illustrate is particularly adapted for small boats in which no other method of power propulsion could be applied. As will be seen, it consists of a small electric motor screwed directly to the rudder-arm, and attached to a flexible shaft having at its end a small screw propeller. The entire weight of the propeller and rudder, which are made by the Electric Boat Company, of 136 Liberty Street, New York, is but 35 pounds, and as the arrangement is easily detached, it can be removed from the boat at any time for safe keeping. Power is furnished by twelve cells of storage battery, weighing 50 pounds apiece and upward, according to the type. The cells are of the usual lighting type, and can be readily charged from any source of direct current. A constant-current type of primary battery of low internal resistance can be used instead of storage cells if it is inconvenient to have the latter charged.

ELECTRIC PROPELLER.

Candle Power of Arc Lamps.

An expert employed by one of the daily papers in Denver, Col., has made the discovery that the arc lamps used on the streets of that city average "only 957.03 candle-power while the city contract calls for 2000 candle-power." On the strength of this report the contracting company has been charged with deliberate fraud, the newspaper employing the "expert" declaring that lamps of only half the required brilliancy are furnished, the city being thereby cheated out of $80,000 per annum !

The Baltimore Electric Locomotive.

Some interesting tests have been made with the electric locomotive used for hauling trains through the Belt line tunnel of Baltimore. Fig. 1 gives an idea of the location of the tunnel and of what its use accomplishes. By its means a reduction of 16 minutes in the running time of the "Blue Line" trains between New York and Washington is now made possible, and it is probable that this saving will be increased later on. Moreover, all delays in Winter due to ice in the river are done away with.

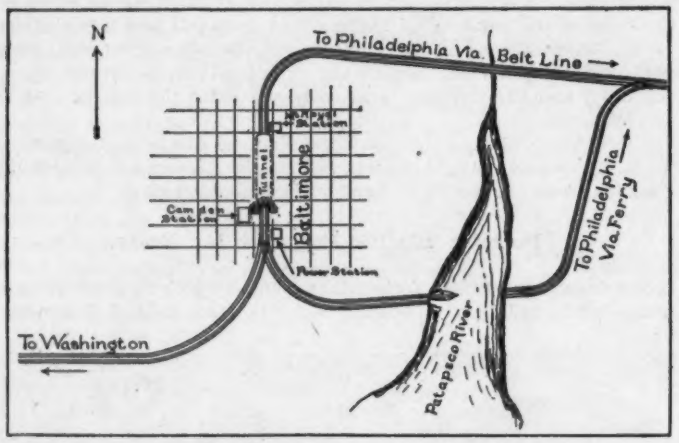


Fig. 1.—Map Showing Tunnel Location.

Probably the most striking test of the power of the locomotive was when two trains were coupled together and hauled through the tunnel. For some reason the freight trains had become "bunched" on the Washington division, and when they did get through they came so fast that it was decided to have the electric locomotive haul them two at a time. The first composite train, therefore, consisted of 44 cars, loaded with coal and lumber, two regular steam freight engines and a steam "pusher" engine. The whole weight was approximately 1900 tons, and was equivalent to about fifty-two loaded cars. The steam locomotives did no work to assist the electric locomotive. The start was made easily and gradually, but when the train was in the tunnel and entirely on the grade the steady, heavy pull was too severe on a defective coupling near the head of the train and it parted. After coupling together again, the electric locomotive started the heavy train, with all drawbars stretched—no slack in the train—and accelerated it to a speed of 12 miles an hour without slipping a wheel, and in every way with the greatest ease. It reminded one of the start of an ocean steamship, so noiseless was it and free from any manifestations other than those of mighty power. The current recorded on the ammeter was about 2200 amperes during the acceleration period, and after the train was up to speed it settled down to about 1800 amperes. The voltage on the line was 625. By reading the amperes the drawbar pull was readily computed and found to be about 63,000 pounds. All four motors were in series, and the maximum pull for that current was therefore obtained.

To determine the drawbar pull exerted for each ampere of current, the Pennsylvania Railway Company's dynamometer car was secured and coupled in between the electric locomotive and a train of known weight. The weight of each car in pounds had been accurately determined beforehand. The regular two-mile haul up grade was then made. When the train was in the tunnel on the grade the pull was uniform, as was shown in the diagrams taken on the dynamometer car.

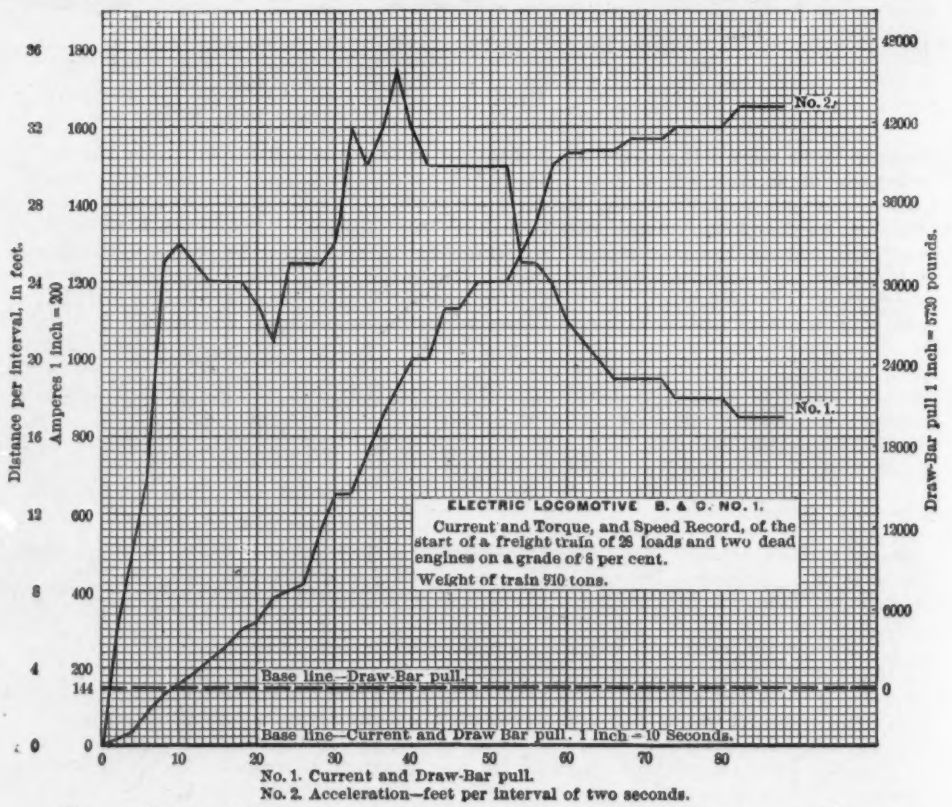


Fig. 2.—Curves Showing Relation Between Current Consumption and Work.

The first test showed (a) how the start was made on the down grade leading to the tunnel; (b) how after the train was fully started the drawbar pull dropped off; then (c) how it gradually increased as the train came on to the 0.8 per cent. grade in the tunnel; and (d) after the train was wholly on the grade, how even the pull was, until near the stop, when the grade increases 1.2 per cent. It was found that 144 amperes were required to drive the locomotive. Fig. 2 shows the current and drawbar pull at any moment while accelerating the train.

For the operation of the Baltimore & Ohio tunnel power-house for the month of October, 1895, the itemized expenses were as follows:

Labor	$1,345 70
Coal ($1.35 per ton)	400 96
Oil and waste	151 26
Water	$50 66
Maintenance	25 42
Total	$1,974 00

The expense on electrical locomotives was:

Motor engineers	$200 00
Oil and waste	12 16
Total	$212 16
Total expense	$2,186 16

There were hauled through the tunnel 353 trains.

Average weight of train	1,095 tons
" time of trip	20 minutes
" current	986 amperes
Distance of trip	4 miles
Total engine travel	1,412 "
" " "idle"	3,756 "
Actual time consumed for above service	118 hours
Idle time for month	626 "

It is customary to consider an engine with steam up as equivalent to six engine miles for each hour it is idle, so that, for comparison, the actual mileage made by the engines must be increased 6 x 626 — 3756 miles.

The large charge of labor at power-house will be the same for one, two and three locomotives in service. The items, coal, water and maintenance, and the expense on locomotives, increase with the number of locomotives in service. If this increase is assumed to be proportional, the total expense and cost per engine mile are as follows:

	Total cost.	Engine miles.	Cost per engine mile.
For one locomotive	$2,186 16	5,168	$.423
" two locomotives	2,875 36	10,336	.278
" three "	3,564 56	15,504	.23

The steam railway records referred to above are for October, 1895, and may be briefly abstracted as follows:

STEAM LOCOMOTIVE PERFORMANCE.

	East Div.	West Div.	Central Div.	N. & W. Div.	Entire Line.
Locomotives in service	74	57	33	28	192
Average engine mileage in service	2,834	2,966	2,293	2,305	2,703
Average cost per engine mile:					
Passenger engines	.1926	.1666	.1629	.1552	.1765
Freight "	.2472	.2656	.3428	.2303	.2615
Switching "	.1489	.1659	.1828	.1425	.1577
Work "	.2391	.2258	.2617	.2169	.2354
Total "	.2084	.2193	.2121	.1797	.2095

From the figures given above it is seen that the actual operating expenses of the electric locomotives for that particular month are about the same as for the freight locomotives on the steam railway, *i. e.*, 23 cents per engine mile. The service of the electric locomotives at that time was only about one third that which it is expected they will have to do when the passenger service is taken up and the line extended the full distance.

As originally intended, a method of using to advantage the power of the station while the electric locomotives are idle is soon to be incorporated in the plant. Under the new conditions the cost per engine mile for the electric locomotives will be far under that of steam.

A comparison of the efficiency of steam and electric locomotives shows slightly in favor of the electric. Observations made on French railways and on the Pennsylvania Railway show that about 45 per cent. to 55 per cent. only of the indicated horse power of steam locomotives is applied

to hauling trains. The efficiency of the Baltimore & Ohio plant is in the vicinity of 60 per cent. to 65 per cent. under normal conditions.

The conductor in the tunnel has now been in position for nine months. During all of this time coke-burning locomotives have been used for passenger service with the consequent presence of a good deal of gas and vapor. For the first six months about half of the conductor was constantly wet from the drip due to leaks in the masonry. This occasioned a muddy, slimy deposit over the insulators and a considerable portion of the conductor. The porcelain insulators are almost entirely obscured in some places by this deposit and that of small particles of carbon given off by the locomotives.

Current was first turned on the line about three months after the tunnel structure was erected. The leak at first was about twenty-one amperes, but, in a day or two, this dropped to about four amperes—the present leakage. The inside of the conductor was coated with a combined deposit of rust and muddy sediment. Heavy currents were taken from it by the contact shoe only with difficulty and the presence of much arcing, heating and showers of sparks. It was found impracticable to run on this surface. By applications of kerosene and frequent scraping with special shoes, a direct contact of the trolley shoe with the conductor was made possible. Although a single-contact shoe then worked with little or no sparking, two shoes in tandem were adopted. Their operation through the conductor is smoother, and the contact over muddy portions of it is more nearly positive. At intervals of about three weeks the conductor is treated with kerosene, and brushing shoes are run through it about one or two trips with these brushing shoes being all that is necessary.

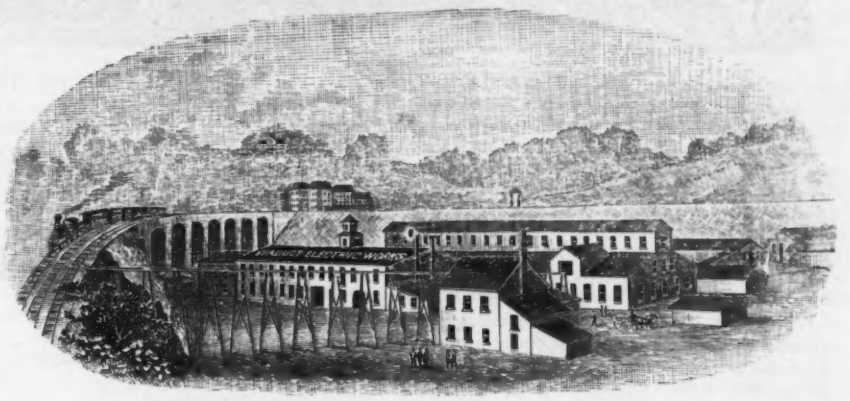
This serves to prevent further accumulation of rust and to remove the sediment from the contact surfaces. An inspection shows a smooth surface over which the shoes run. Contact with the metal is seen to be in high spots and thin lines which are slowly increasing in extent. No considerable sparking now occurs, except at the wet places, where it is occasioned by the presence of water and sediment. With the exception of three places, about 200 feet long, each, the conductor is at present dry.

A Modern Electrical Factory.

The new works of the Viaduct Manufacturing Company, Baltimore, Md., are on a much larger scale than the old plant, completely destroyed by fire, which they replace. The principal buildings are 100 x 40 feet, 200 x 48 feet and 68 x 48 feet, respectively, and, as will be seen from the accompanying illustration, are well located with respect to shipping facilities. In addition to the above-mentioned buildings, there are also a dry-house, forge and office building, all brick, and a large lumber shed. The entire plant is run by water power, but a gas engine is installed for emergencies. The new works were inaugurated with considerable ceremony.

Two foremen who have been in the employ of the company for a quarter of a century were in charge of the celebration. A straight white 75-foot pole had been set up between the machine shop and the power house, surmounted by a 10-inch gilt ball, and from this a 20-foot "Stars and Stripes" was unfurled. The employees gathered in a group about the foot of the flag staff and the ceremonies began, and Mr. Carroll Miller, of Baltimore, made the presentation speech on behalf of the employees. He reviewed the patriotic history of the "Stars and Stripes," and urged that the folds of the flag be never dishonored. A daughter of Frank M. Dunn, manager of the company's city office, stepped forward at the conclusion of Mr. Miller's speech and hoisted the bunting to the top of the pole. The bystanders stood with bared heads, and a number of them sounded salute on horns which they carried. Charles Smithson, one of the employees, played the "Star-Spangled Banner" on a cornet.

Mr. Augustus G. Davis, president of the company, responded to the presentation speech with a few words of acceptance and good cheer for the employees. Arthur Davis, Jr., George Geer, J. H. R. Hinton, John Coates and William Downey comprised the committee in charge. Every department of the reconstructed works is on the ground floor. All of the buildings are filled with the most approved machinery for manufacturing small electrical goods. Telephone apparatus, including magneto bells and district messenger boxes, are the principal articles made. About 100 persons are employed at the works, including a number of girls. Nearly one third of the number live in Baltimore and travel to and from their work on the B. & O. Railroad.

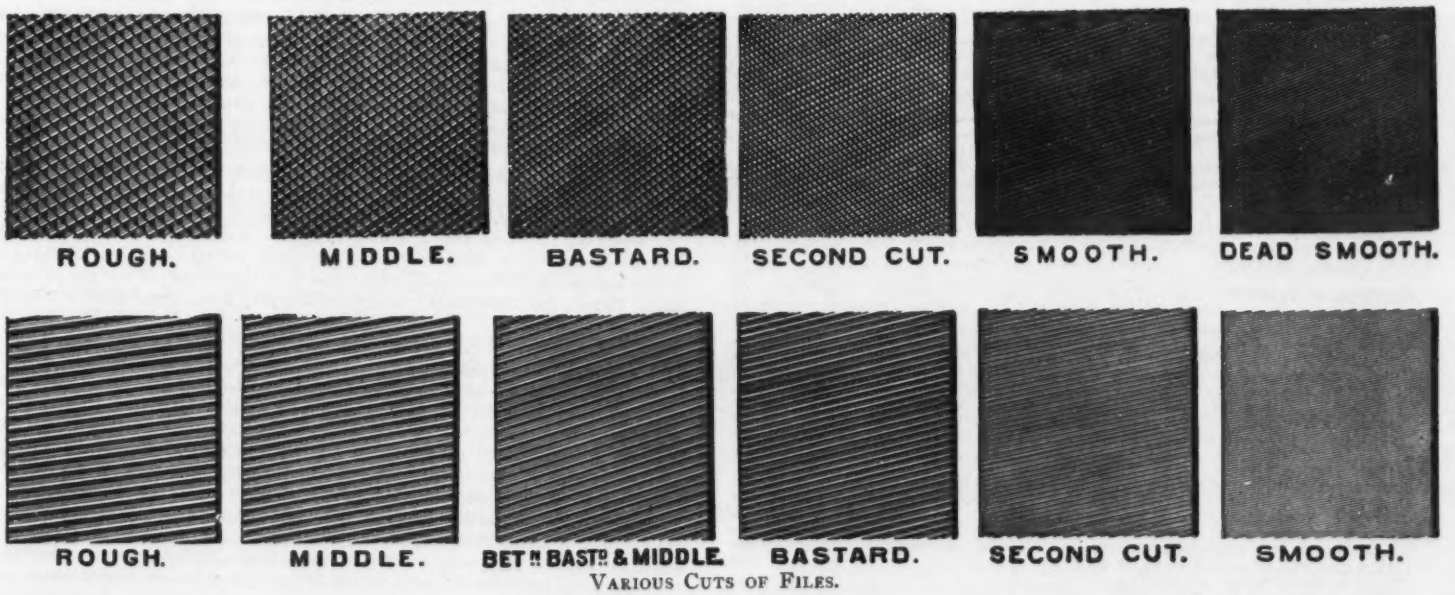


THE VIADUCT FACTORIES.

The officers of the Viaduct Company are: President, A. G. Davis; manager, A. B. Davis; treasurer, J. Harry Lee; secretary, Wm. H. Winkelman.

File Cuts.

Owing to the misapprehension which frequently exists as to the character of the cut which gives its name to a file, we print herewith some illustrations showing a number of the more usual file cuts. The engravings are fac-simile, and refer to files 12 inches long. The files represented in the first row are mostly of the kind used in machine shops. Those in the second row are frequently employed by machinists for lathe work, finishing purposes, etc., but are mostly used by workers in wood, carriage-smiths, etc. We are indebted to the G. & H. Barnett Company, of the Black Diamond File Works, Philadelphia, for the accompanying engravings.



VARIOUS CUTS OF FILES.

Electric Power Pumps.

In an article in these columns in the issue of Feb. 29, the manufacturers of the electric power pump described on page 232 were stated to be the "Knowles Company of Brooklyn." The error was doubtless recognized by the majority of our readers, as the Knowles Steam Pump Works, of 93 Liberty Street, New York, the manufacturers of the pump referred to, are so widely known throughout the country in connection with the pump industry that the mere mention of the name in connection with advances in pump making would have identified it to most of those reading the article.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 29, 1896.

AMERICAN BELL.—The instrument statement of the Bell Company for the month ended Feb. 20 shows a net output of 10,857 instruments as compared with 3664 last year. The total number outstanding was 607,445, against 587,856 on Feb. 20, 1895. The stock has been steady at 203 throughout the week.

GENERAL ELECTRIC.—The annual report of the General Electric Company, while lacking some figures, is near enough completion to indicate the probability of earnings upon the common stock of 3 per cent., and it is thought an increase in the surplus will be shown as well as in earnings. This is the first report for a long time in which such a favorable showing has been made Bears on General Electric claim that if the stock is cut in two at the next annual meeting in the effort to fix up the impaired capital account, the stock at 60 would be comparatively high, and therefore they think it may work lower, as many people object decidedly to any reduction in the amount of stock which they hold, no matter what its increase in value may be.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	95	96
" " " Brooklyn	100	110	115
" " " Boston	100	145	150
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	27½	28
Electric Storage, pref	100	28½	29
General Electric	100	31⅛	31½
General Electric, pref	100	60	62
Westinghouse Consolidated, com	50	28¾	30
" " pref	50	52	53

BONDS.

Edison Electric Ill., New York	105	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	..	90¼

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	203	203½
American District Telegraph	100	33	40
American Telegraph & Cable	100	92	93
Central & South American Telegraph	100	117	120
Commercial Cables	100	150	..
Erie Telephone	100	60¾	61
New England Telephone	100	88½	89
Postal Telegraph-Cable	100	85	86
Western Union Telegraph	100	83	83¼

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17	17¼
Brooklyn Rapid Transit		22⅞	23½
Brooklyn Traction	100	9½	11
" " pref.	100	53½	55½
Buffalo St. Ry	100	69	72
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	49	50
Hestonville	100	..	50
" pref		..	63
New Orleans Traction	100	16	18
" " pref	100	61	63
North Shore Traction	100	30	33
" " pref	100	80	83
Rochester St. Ry	..	27	35
Steinway, Ry	..	49	..
Union Railway (Huckleberry)		99	102
Union Traction, rcts $5 pd	..	10¼	10⅜
West End, Boston	100	68	68½
" " pref	100	88	90
Worcester Traction	100	16	19
" " pref	100	87	90

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	79	81
Buffalo St. Ry. 1st con. 5s	100	104	107
Cleveland Elec. Ry. 1st mtge 5s	100	101	103½
*Columbus St. Ry. 1st 5s	100	95	100
Rochester St. Ry. 1st 5s	100	98	101
Union Railway (Huckleberry) 1st mtge 5s		103	105½
*Westchester Electric 1st mtge 5s	100	100	102

* With accrued interest.

BROOKLYN TRACTION has about monopolized the traction market this week, the heavy trading being due to the publication of the terms of the Atlantic Avenue lease. Probably more Brooklyn Traction stock has changed hands during this week than in any other in the history of the company.

BUFFALO RAILWAY stock is inactive, but holds firm around 70 ex-dividend.

CITIZENS' STREET RAILWAY.—Various rumors are current to account for the decline in Citizens' (Indianapolis) stock. An expert is said to have been sent to report on the condition of the property. On his return the stock was offered down in blocks of 500 shares in spite of the fact, it is said, that he found the road in first-class condition. Others attribute the decline to internal dissensions, and to an endeavor by a pool to obtain control of the road. The question of the charter has never been conclusively settled.

NEW ORLEANS TRACTION securities, in spite of January report of earnings, show some signs of weakness. The net earnings for that month were $49,944, an increase of about $15,779.

WORCESTER TRACTION continues to advance, and as the market is practically bare of stock few transactions are recorded.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, March 1, 1896.

THE BOYNTON MULTIVOLT BATTERY COMPANY has removed from Brooklyn to 169 Greenwich Street, corner Cortlandt Street, New York City.

MR. CHAS. DAVIS, of the Davis & Egan Machine Tool Company, Cincinnati, O., is now in the East on a visit to the various branches of his company in order to make arrangements for the handling of its increasing business during the present year.

THE CARD ELECTRIC MOTOR & DYNAMO COMPANY, of Cincinnati, O., has opened a New York office in the building of the American Tract Society, corner Nassau and Spruce Streets. The office will be in charge of Robert T. Lozier, a well-known electrical engineer, formerly connected with the General Electric Company.

MR. H. J. OSBURN, of the Osburn Electric Supply Company, of Chicago, has been making a trip through the East in the interest of the new interior conduit, which his company is now prepared to place on the market. During a call at the office of THE ELECTRICAL WORLD, Mr. Osburn stated that his company was doing an excellent business and anticipated a large demand for its conduit.

THE BRYAN-MARSH COMPANY, 136 Liberty Street, claims to have recently closed several of the largest contracts ever entered into for incandescent lamps for street railway service. Among these are one with the Brooklyn Heights Railway Company, of Brooklyn, N. Y., and one with the West End Street Railway Company, of Boston, the latter being for 30,000 lamps, and the second contract made with the West End Company.

THE BI-METALLIC ELECTRIC TRANSMISSION COMPANY has opened an office at 1204 Havemeyer Building, 26 Cortlandt Street, where it is prepared to quote prices, all sizes and in any quantity, on bi-metallic wire. This wire is composed of a copper sheathing over a steel core, thus combining conductivity, tensile strength and the "bi-metallic" effect. The wire, which is claimed to be perfect mechanically, is made for the Bi-Metallic Company by the John A. Roebling's Sons Co.

THE ELECTRICAL ASSOCIATION OF BROOKLYN was organized Feb. 28, at a meeting of which Mr. G. H. Wood was chairman, and Mr. M. R. Rodrigues secretary. The object of the association will be the promotion and study of the arts and sciences connected with the electrical and allied industries, and the welfare of those interested, and also the maintenance of rooms and the procurement of apparatus and literature for the use of members. For further information the secretary may be addressed, at 17 Whipple Street, Brooklyn.

THE INTERIOR CONDUIT & INSULATION COMPANY, 527 West Thirty-fourth Street, has adapted its well-known conduit to the wiring of street cars. The car is provided with a complete system of insulating tubes concealed in the framework, and the outlets are arranged with a view to facilitating the withdrawal and replacing of the wires. The system possesses the strong features of thoroughly protecting the wires and yet keeping them entirely accessible, and the question of its convenience and general advantages does not admit of argument; it is perfectly obvious.

CHAS. A. SCHIEREN & CO., the well-known belt manufacturers of New York, Boston, Philadelphia and Chicago, have just received an order for four belts, 36 inches in width, and double ply, of their perforated electric brand, for two electric light plants in France. This order will amount to $3100. Their export business has been on the increase despite the recent war talk and unsettled financial conditions. Among recent domestic orders they report the sale of 136 11-12 feet of 54-inch double, and 146 11-12 feet of 48-inch double electric belting to the Electric Illuminating & Power Company, Long Island City, N. Y.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 28, 1896.

THE ÆTNA ELECTRIC COMPANY, Hartford, Conn., reports increasing sales for its incandescent lamp manufactures, and particularly for Alpha lamps, its new idea in electric advertising.

THE DAVIS ELECTRICAL WORKS, Springfield, Mass., is busy filling the constantly increasing orders for its incandescent lamps, and Manager C. F. Munder presents every evidence of corresponding satisfaction. To Mr. Munder's energetic efforts, by the way, the company's successful business is in large measure due.

THE ELECTRIC RAILWAY SWITCH & SUPPLY COMPANY, Springfield, Mass., is making excellent progress with its new switches, and Treasurer L. L. Davis is concluding agency arrangements which promise to rapidly extend their introduction. Some very handsome switches have just been completed for electric railway work.

A PATENT SUIT.—The Bryant Electric Company, of Bridgeport, Conn., has been successful in a suit for infringement brought against it by O. S. Platt, concerning the Bryant push-and-pull switch. The Bryant Company denied that the switch it makes is in every way an infringement, claiming that it was merely another application of old ideas. This view of the patent has been sustained by Judge Townsend, of the United States Circuit Court.

MESSRS. I. B. DAVIS & SON, Hartford, Conn., are well-known to the electrical trade as manufacturers of the Berryman feed-water heater and purifier and the economic boiler and tank feed pump, both of which are in extended use by electric light and street railway companies and giving general satisfaction. We were much pleased recently to make the acquaintance of Mr. John O. Davis, to whose energy and business ability is due the success of these important adjuncts to steam and electric plants.

THE PRATT & WHITNEY COMPANY, Hartford, Conn., is certainly one of the largest and best-known establishments in the world devoted to the manufacture of machinists' tools. Upon a recent visit it was difficult to determine whether the contented and happy countenance of Treasurer Reed was due to the continued good business which the company is enjoying, or to the fact that in the newly constructed office home of the Pratt & Whitney Company there is ample facilities for the transaction of the company's business.

THE DEANE STEAM PUMP COMPANY, of Holyoke, Mass., soon expects to announce a novelty in the shape of a pump direct-connected to a motor for use in mines. The Deane Compai y continues to do a large and growing business with electrical companies. General Manager Lewis E. Bellows has given personal attention to this branch of the company's business, and is thoroughly competent to advise those who are not as well informed as to how economy and efficiency can be best combined in adapting pumps for use in connection with electrical street railway plants.

THE CROWN WOVEN WIRE BRUSH COMPANY, Salem, Mass., is receiving several very flattering testimonials as to the excellence of its brushes, and every effort is being exerted to keep up the standard, using nothing but the purest material in their manufacture in connection with first-class work, hence any one wishing anything in this line will do well to keep in mind this company, and be convinced that its brushes are all that they are claimed to be. The "Crown" is noiseless, easy and flexible and will not spark, heat or cut the commutator. Messrs. F. S. Burke, manager, and J. Orne Ryder, secretary and treasurer, are both progressive and energetic business men.

THE BILLINGS & SPENCER COMPANY, of Hartford, Conn., devotes more and more attention each year to the manufacture of drop forgings for electrical purposes. Its customers include the larger electrical and manufacturing companies. Commutator bars has for a long time been one of its specialties, and something over a year ago it introduced to the electric railway field a special and varied line of drop-forged overhead railway equipment, which at once attracted attention and has steadily increased in popularity ever since. Under the guidance of Superintendent F. C. Billings, the writer recently enjoyed a visit through the works of the Billings & Spencer Company and found the plant one of the most extensive, busy and well-arranged manufacturing establishments he has seen in a long time.

WASHINGTON NOTES.

WASHINGTON, D. C., Feb. 21, 1896.

PRESIDENT PHILLIPS, of the Metropolitan road, states that the business of the Ninth Street line has increased 100 per cent. since the installation of the electrical system.

ELECTRICIAN JOSEPH COLVIN, of the Washington, Alexandria & Mount Vernon Electric Railway, had a train of the new cars on the streets trying them the other day. He was also testing the curves. At one corner he experienced a little difficulty, but outside of this the cars worked satisfactorily.

THE COLUMBIA & MARYLAND RAILWAY COMPANY has given a contract to the Westinghouse Company of Pittsburg, to build two power houses on its proposed trolley line between Washington and Baltimore. Both will be substantial buildings 120 x 250 feet, equipped with the latest electrical appliances, and the contract calls for their completion by May 15.

A BILL HAS BEEN INTRODUCED in Congress by Representative Quigg of New York, to provide for the extension of letters-patent for an "improvement in insulating submarine cables." The extension is asked to be granted to Baker A. Jamison and Tallmadge A. Lambert, administrators *de bonis non* of George B. Simpson, for the term of seven years, upon payment of the usual fees and charges for the extension of patents.

IT IS UNDERSTOOD that the Georgetown & Tennallytown Railway Company is endeavoring to purchase the Tennallytown and Rockville road, better known as the Bethesda line, and has offered that corporation within $2000 of the price asked. If the deal is consummated the Georgetown corporation will begin at once the extension of the Bethesda line to Rockville, over a route which has already been surveyed. Electric light wires will be strung along the line of the new road, and light will be furnished to those who want it.

THE FRIENDS OF DANIEL DRAWBAUGH were given a hearing by the Senate Committee on Patents last week. Mr. Drawbaugh claims to be the original inventor of the microphone. His application was thrown out of the Patent Office, on the ground that a device of the same character had been in use two years when he asked for a patent. Mr. Drawbaugh's friends are making an effort to secure legislation, whereby he may be allowed to proceed with his application for a patent. The probability of an early decision by the United States Supreme Court on the validity of the Berliner patent, adds interest to the Drawbaugh move.

IN THE ANNUAL REPORT of the Washington & Marlboro Electric Railway Company, which has been transmitted to Congress, is the statement that an amendment in the act of authorization requires it to pass over the Anacosta River by a bridge constructed with a draw apron. This was found and believed to be an impossible thing in an electric railway line, involving also a perpetual menace to the safety and lives of passengers. It was therefore judged unwise to take further steps until some mode could be devised and the sanction of Congress obtained to obviate so grave a difficulty. All subscriptions of stock are consequently held in trust by the directors for the benefit of the company.

PRESIDENT NEWBOLD, of the Eckington and Belt roads, had a brief conference with Senator McMillan, of Michigan, recently. Mr. Newbold was emphatically assured that the committee could not consent to the Seventeenth and M Streets extensions under any circumstances, and was adverse to granting any extension rights until the road should improve its present system. Mr. Newbold stated that he had been looking into the matter of compressed-air motors, and hopes to have them on his lines before many months. Senator McMillan informed him that the committee was not disposed to favor any experimental and probably impracticable methods of propulsion while the city possessed such an excellent demonstration of the value and utility of the underground electric system as that afforded by the successful working of the Ninth Street line.

IT IS BEING CLAIMED that the electricians of the Capitol work too many hours a day; 11 and 12 hours is the rule, with an occasional Sunday thrown in. Each year has seen an increase in the use of electric lighting at the Capitol. It was only at the beginning of the present session, however, that Congress owned its own plant. Twelve men are required at the Capitol to look after the motors, wires and lamps that furnish the committee rooms and both legislative chambers and the Supreme Court with electric light. Eight of the men are required to look out for the lights during the day, and four at night. All of the men are overworked, and say that their lot is such a hard one that it is almost unbearable. They claim that by the addition of even four more men the work for all would be considerably lightened, and they could get a little time to go home to their families.

THE TREASURY DEPARTMENT has just announced the following important decision regarding trade marks: "No article of imported merchandise which shall copy or simulate the name or trade mark of any domestic manufacture shall be admitted to entry at any custom house of the United States. And in order to aid the officers of the customs in enforcing this prohibition any domestic manufacturer who has adopted trade marks may require his name and residence and a description of his trade marks to be recorded in books which shall be kept for that purpose in the Department of the Treasury, under such regulations as the Secretary of the Treasury shall prescribe, and may furnish to the Department *fac similes* of such trade marks; and thereupon the Secretary of the Treasury shall cause one or more copies of same to be transmitted to each collector or other proper officer of the customs."

THE DISTRICT COMMISSIONERS have made their long-looked-for gas bill public and sent it to Congress. It is a substitute for all pending bills to charter telephone, electric light and gas companies Regarding the use of the public streets by electrical companies the act proposed the renting out of these franchises to the highest bidder for 30 years. The companies using the public streets are required by the measure to bid in the manner of a contractor, and they will be required to divide with the district government all earnings in excess of 6 per cent. per annum on their actual capital stock. The telephone and lighting companies will be required to construct conduits under the supervision of the engineer department, and they cannot refuse to rent out unoccupied space in their ducts to any competing company. The bill prohibits the further laying of conduits, except under its provisions, and whenever a conduit is laid under its provisions all the overhead wires along that street shall be put in the conduit within 30 days. A penalty is provided of $5 a day for maintaining overhead wires in a street in which there is a conduit. The measure gives the commissioners the right to purchase or reject all existing conduits. The company securing the right to lay conduits in the streets will have the right to collect the rent for unoccupied spaces which they must rent to the competing companies. If they fail to agree upon terms, then the commissioners will settle the dispute. Spaces must be reserved in these conduits, according to the measure, for the free use of the District. The company holding the contract must construct conduits anywhere in the District the commissioners may direct, and they must be repaired at the direction of the commissioners. If the company fails to comply with the provisions of the act, its property reverts to the District.

WESTERN NOTES.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, Ill., Feb. 27, 1896.

MR. MAX BERG, of the Ohio Brass Company, Mansfield, O., was in Chicago for a few days this week, attending the wedding of a friend.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY is getting up a very handsome and handy catalogue of the numerous telephone devices which it handles, and of other well-known specialties.

THE PARTNERSHIP heretofore existing between Ashley D. Scott and Frederick J. Pearson, doing business under the name of the Scott-Pearson Engineering Company at St. Louis, Mo., has been dissolved by mutual consent. F. J. Pearson will collect all accounts due and will pay all indebtedness of the former firm.

THE WASHINGTON ELECTRIC COMPANY, of Chicago, under the supervision of Mr. W. O. Meissner, has found it necessary on account of his growing business to remove his headquarters from Canal Street to the Rus-

sell Building on West Randolph Street, where he has ample room for the new machinery that he has added to his plant. The firm is now very busy with its many specialties, such as theatre dimmers, theatrical lamps and telephone specialties.

W. D. BALL & CO., consulting electrical and mechanical engineers, 1625 Monadnock Block, is the style of the firm succeeding the partnership of Ball & Allen, which has been dissolved, Mr. Allen retiring. The new firm is composed of Mr. W. D. Ball, who has been well known in engineering circles for several years, and Mr F. E. Drake, formerly the general agent and assistant manager of the Standard Electric Company. The new firm will continue to do consulting and engineering work, Mr. Ball taking the technical end, while Mr. Drake will have the management, caring for the general business.

MR. WILLIAM H. BRYAN, consulting engineer, St. Louis, has entered into an agreement with Mr. H. H. Humphrey, by which the latter becomes associated with him in the business of consulting, electrical and mechanical engineering. Mr. Bryan informs us that his special work is steam and mechanical engineering, particularly in water works, steam heating and ventilation and boiler practice, which has grown to such an extent as to demand almost his entire attention. This left little or no time for electrical engineering, to which department, however, Mr. Humphrey will now give his attention. Mr. Humphrey is thoroughly equipped for this work, both by education and practical experience, and stands high among the electrical fraternity in the West. This new arrangement went into effect March 1.

Denver Notes.

Denver, Col., Feb. 24, 1896.

RÖNTGEN RAYS.—Successful experiments with the Rontgen rays have been made in the laboratory of Colorado College, at Colorado Springs, by Profs. Strieby and Cajori. They succeeded in securing excellent negatives of a geranium leaf and a star cut from lead foil. Successful experiments have also been made by Prof. Dexter at the State Normal School at Greeley.

THE DENVER CITY CABLE COMPANY has under consideration a project for the construction of a electric cross-town line on Washington or Clarkson avenue, and extending south to the limits of the suburban district. Col. Randolph, the receiver of the company, says that the report that the company proposes to sell eight tickets for 25 cents is entirely without foundation.

THE FIRST ELECTRIC DRILLING PLANT in the Cripple Creek district is to be installed in the Columbine Victor mine, controlled by the Woods Investment Company, of Colorado Springs. The contract has been awarded to the Marvin Electric Drill Company, of Canastota, N. Y. A power station 40 x 60 feet is to be built at the West End of the Columbine Victor tunnel.

THE COLORADO TELEPHONE COMPANY proposes to build an extension to its long-distance system connecting Florence and the Cripple Creek district to meet the demands for communication between the mining towns and the smelters. The circuit will terminate at the town of Victor where the famous Portland and Independence Mines are located. The line will probably be about 20 miles in length.

LIEUT. IRVING HALE, manager of the Denver office of the General Electric Company, has declined to serve on the committee appointed by Mayor McMurray, to investigate the charge that the Consolidated Electric Company was not furnishing the city with arc light of the candle-power required by contract. The Mayor appointed in the place of Lieut. Hale Mr. Thomas B. Stearns, of the Stearns-Rogers Manufacturing Company, of Denver.

AN ELECTRIC RAILWAY connecting Denver and Cripple Creek is projected by the South Platte Railway & Power Company, which has just been incorporated with a capital of $1,000,000 by Sylvester T. Smith, J. E. Rockwell, and others. The company proposes to use water-power at different points along the line for the operation of the railway. Some of the richest and most influential capitalists of Colorado who are interested in Cripple Creek are said to be back of the enterprise.

THE TELLURIDE POWER TRANSMISSION COMPANY is installing at the Ophir loop on the Rio Grande Southern Railway the largest electrical mining plant designed for use in the Rocky Mountain region. The generating plant will be operated by water-power from the Lake Fork and Howard's Fork of the San Miguel River. The pipe line in the former is 3000 feet long, while that in the Howard Fork is about one mile long. In the one case the fall is 310 feet, and in the other 525 feet. Pelton water-wheels are used. The plant consists of two-phase electrical apparatus supplied by the Westinghouse Company, and is an addition to a single-phase plant now in service.

THE DENVER, GLOBEVILLE & ARGO RAILWAY COMPANY has received a franchise from the trustees of Argo, and rights through most of the suburban towns on its route have been secured. The company proposes to build a line from Fortieth and Market Streets in Denver to Golden, 14 miles from the city in the foothills, passing through Globeville, Argo, Elyria and on the north shore to connect with the West End Electric Railway, and thence through Jefferson County to the terminus. The company has not yet succeeded in securing a franchise from the Denver Aldermen. It has agreed to pay for the privilege of constructing its line 2 per cent. of the gross earnings for the first two years, and 5 per cent. during the remainder of the life of the company.

THE BAILEY ELECTRIC EXTRACTION PLANT, at Cripple Creek, has been in operation for over two months, and according to Mr. J. W. Bailey, of Denver, the inventor of the process used, the results have been wonderfully successful. Mr. Bailey combines in his mill a process of obtaining gold by electrolysis, in connection with a method of treatment by cyanide solution. For the electrolytic process he uses a dynamo specially built by the General Electric Company, having an output of 50 amperes and 30 volts. The actual cost of the treatment of ore by the Bailey process is not over $1 per ton, at the present small mill, under the conditions which prevail at Cripple Creek, where coal costs $5.50 or more per ton, and where water must be purchased at a high rate, as well as fuel. When a large mill is erected, having a capacity of 100 tons per day, and with coal at a reasonable figure, the cost, Mr. Bailey states, can be reduced to 60 cents per ton. The cost by the ordinary cyanide treatment is generally stated to be about $3 per ton, but Mr. Bailey is authority for the assertion that this figure is an underestimate, and that $4 is more nearly correct. He does not, however, emphasize the economy of his process, so much as its efficiency in extracting all the gold contained in the ore.

English Notes.

(From Our Own Correspondent.)

London, Feb. 19, 1896.

THE WESTINGHOUSE CLOSE-CONDUIT SYSTEM.—I announced some time ago that the Leeds Corporation had decided to make an experimental trial of the Westinghouse close-conduit on a short section of their line on the advice of Dr. John Hopkinson. This idea has, however, now been abandoned, and the experimental lines about to be inaugurated by the Leeds municipal authorities will be on the overhead trolley systems.

TELEPHONE DEFENCE ASSOCIATION.—An association calling itself the "United Kingdom Telephone Defence Association" has recently been inaugurated under the auspices, among others, of Prof. Silvanus Thompson, Mr. R. E. Crompton, Major-Gen. Webber, Mr. A. R. Bennett, late of the National Telephone Company; Mr. James Swinburne and Prof. A. B. W. Kennedy. The object of the association is stated to be to secure for telephone users in England facilities approximate to those given in Continental countries. It is proposed to issue circulars to all the telephone subscribers in the country, calling upon them to bring about urgent representations to Parliament against the existent telephone monopoly, and to petition for an extended service and reduced rates.

STEAM SUPER HEATING.—At the Institution of Mechanical Engineers, Mr. W. H. Patchell recently contributed a paper on steam super-heating in which he reviewed the history of the subject and gave a number of tests of various kinds of super-heaters now in use. Mr. Patchell is the chief engineer at the Maiden Lane station of the Charing Cross & Strand Electricity Supply Corporation, and he has installed three McPhail & Simpson super-heaters in his boiler plant. He found that not only have these improved the quality of the steam, but that he can get a greater amount of steam out of a given boiler plant when they are in use. For example, one of his stokers managed to get 10,125 pounds of steam per hour from a boiler which was rated at a maximum of only 3457 pounds; that is to say, nearly treble duty. In the discussion which followed the reading of this paper several engineers connected with the electrical industry took part, and the general impression seemed to be that we are on the eve of a very considerable extension in the use of super-heaters in stationary engine practice.

HOUSE WIRING.—The discussion on the two papers on house wiring, read before the Institution some six or more weeks ago, was continued on Thursday evening last and again adjourned. There was a strong expression of pious opinion, but comparatively few deductions from actual experience. Once more there was a tolerably strong concensus of opinion in favor of concentric wiring, or failing that wrought-iron tubes containing two well insulated conductors, the system of interior conduit tubes which Mr. Fred Bathurst is seeking to introduce into this country meeting with a comparatively cold reception. One speaker said that the necessity for high insulation was caused wholly and solely by moisture. He mentioned a case which occurred some 10 years or more ago, in which comparatively poorly insulated wires were run in a well-dried house in grooves cut in the brickwork, the grooves being filled with plaster-of-Paris and then papered over. At the present time the insulation resistance of this system was as high as that of a far more elaborately designed and erected wiring. An interesting point was brought out by Mr. G. L. Addenbrooke, who laid stress upon the importance of the wiring question solely from the aspect of its cost. In the United Kingdom, he said, the returns of the various central stations show that the cost of a kilowatt capacity, including mains, amounted on an average to about £100, and that each kilowatt capacity at the central station meant about 40.8 cp lamps connected, the cost of the wiring of which amounted on an average to about £1 per lamp. In other words, the cost of house wiring in the United Kingdom amounts to nearly 50 per cent. of the total sum spent on electric supply stations and mains. Several speakers, while admitting the advantages of interior conduit or concentric wiring, doubted whether they would in any way lessen the cost of wiring, which, at the present moment, was the main object electrical engineers should have in view.

General News.

Telegraph and Telephone.

LEON, IA.—Leon is to have a local telephone exchange.

BARDWELL, KY.—A telephone system is to be installed.

JACKSON, MISS.—A new telephone exchange will shortly be built.

ALTON, IA.—A telephone line from Alton to Paulina is being talked of.

GLASGOW, KY.—Glasgow is to have a telephone exchange at an early date.

LANCASTER, WIS.—A telephone system is to be installed here in the near future.

PERSIA, IA.—A telephone line will be extended from Persia to Logan in the Spring.

GRAFTON, N. D.—Grafton and Grand Forks will be connected by telephone in the Spring.

NORTHFIELD, VT.—Northfield is soon to be equipped with a new telephone service.

BARDSTOWN, KY.—Balltown, New Haven and Bardstown are soon to be connected by telephone.

HAZELHURST, MISS.—The Mississippi Telephone Company is building a telephone exchange in this place.

BELLAIRE, O.—The Ohio Valley Telephone Company, of Bellaire, has been incorporated with a capital of $10,000.

LAUREL, ILL.—Laurel expects to soon have a telephone line connecting the town with several places in Maryland.

BOSCAWEN, N. Y.—A movement is on foot to erect a telephone line between Boscawen and Shaker Village in Canterbury.

GILMAN, ILL.—The Holden Telephone Company, of Rock Island, Ill., has obtained a franchise to establish its system in this place.

CARTHAGE, ILL.—W. H. Hartzel, J. C. Ferris and Chas. De Hart are figuring on establishing a city telephone system for Carthage.

CARROLLTON, MO.—A telephone line is to be established from Winchester, through Manchester, Roodhouse, Whitehall and Carrollton.

ALLISON, IA.—It is stated that a telephone line will be established between this point and Grundy Centre, *via* Parkersburg, in the near future.

ALBUQUERQUE, N. M.—The Colorado Telephone Company is making arrangements to connect this city with a number of neighboring towns in this county.

MERIDAN, MISS.—Capt. Gallagher, of Meridan, is forming a company for the purpose of establishing a telephone line between Waynesboro and Meridan, a distance of 55 miles.

RICHMOND, PA.—A local telephone line is soon to be erected between Richmond and Bangor, and another local line is to be erected between the latter place and Stone Church.

ELSBERRY, IA.—A company has been formed and all the stock subscribed for a telephone line connecting Elsberry with Troy, Winfield and other important towns in Lincoln County.

COLUMBUS, GA.—A long-distance telephone line will soon be built from here to Opelika, Ala., and it is probable that the entire State of Alabama will be covered with a network of wires before long.

GALESBURG, ILL.—There is some prospect that Galesburg will have a new telephone system. Hon. Tom Marshall, of Keithsburg, is projecting a plan to extend a line from Monmouth to Galesburg.

MARINETTE, WIS.—A franchise has been granted to the Menominee River Telephone Company to erect and maintain a telephone system in Marinette. The same company has also secured a franchise in Menominee.

BELLEFONTE, PA.—J. Spigelmyer, G. L. Frank, A. Walter, A. A. Frank and C. S. Musser, of Millheim, have applied to the Governor for a charter for a corporation to be known as the Millheim Electric Telephone Company. The Millheim Company will build lines to connect the towns of Coburn, Aaronsburg, Rebersburg, Madisonburg, Spring Mills, Center Hall and the surrounding villages with Millheim, extending the line to Bellefonte.

ELECTRIC LIGHT AND POWER.

ASHLAND, WIS.—The electric lighting plant and electric street railway have been sold on foreclosure of mortgage.

RICHFIELD SPRINGS, N. Y.—The electric light and power plant here has been burned. Loss, $20,000, with no insurance.

ALAMEDA, CAL.—A. L. Fish was awarded the contract to furnish engines and boilers for the municipal electric light plant.

PORT JEFFERSON, N. Y.—The newly organized electric light company has purchased a lot preparatory to building a central station.

FREDERICKSBURG, TEX.—The electric light company has obtained its charter, and work will be begun installing the plant at once.

ANTWERP, N. Y.—At a special election a municipal electric light proposition was carried. The electric light plant will cost about $6000.

WHITEHALL, ILL.—The City Council has entered into a contract with C. P. Woodworth, of Chicago, to build a municipal lighting plant.

RICHMOND, IND.—The City Council of Richmond has appointed a board of appraisers, looking to the purchase of the Richmond electric lights.

KINGSTON, N. C.—An electric plant is to be erected here. The city authorities have decided to take 25 or 30 arc lights when the plant is completed.

HOLLIDAYSBURG, PA.—The Hollidaysburg Council has voted to issue a $12,000 loan for the establishment of an electric light plant to be owned by the city.

PLAINWELL, MICH.—The electric light plant has been damaged by fire. The plant was owned and operated by the Plainwell Church Furniture Company.

SOLVAY, N. Y.—At a village meeting a vote was taken in regard to purchasing an electric lighting plant, which was carried by a majority of 48 out of 50 votes cast.

WINONA, MINN.—The electric light plant and electric street railway of the Winona General Electric Company will be sold April 13 to satisfy claims of bondholders.

ANAHEIM, CAL.—More lights are wanted and the municipal lighting plant will be enlarged. It is estimated that it will require about $1500 to make the necessary additions to the plant.

WALDEN, N. Y.—The Wallkill Valley Electric Light Company will enlarge its plant by adding an engine and incandescent dynamo. A. J. Fowler, treasurer, may be addressed.

AUSTIN, TEX.—At the meeting of the Council it was reported that in a short time the city would have to invest thousands of dollars in new machinery, as the present machinery is nearly worn out.

GRAND RAPIDS, MICH.—Bonds to the amount of $150,000, issued for the erection of a municipal lighting plant, have been sold to Rudolph Kaybolte & Co., of Cincinnati, at a premium of over $5000.

OSGOOD, IND.—Osgood may be lighted with electric lights. John Myers is here from Greensburg to see about erecting an $8000 plant. He will furnish the capital if the citizens will accept the lights.

BROOKLYN, N. Y.—Extensive improvements along the river front are contemplated by the Brooklyn Wharf & Warehouse Company. An electric railway will be built for the better handling of goods, and it will be so constructed that each dock can be communicated with rapidly.

KNOXVILLE, TENN.—The new electric light plant about to be installed by the Brookside Cotton Mills, Knoxville, Tenn., will consist of a General Electric dynamo and a Ball engine of the Ball Engine Company, Erie, Pa.

BONHAM, TEX.—The Bonham Electric Light & Power Company has been organized with a cash capital of $25,000. It has purchased the old electric lighting plant, and proposes to add to its capacity, and also furnish electric power for motors, and to run the street railway with electricity.

CHILLICOTHE, MO.—At the meeting of the City Council the report of the Light & Water Committee was received recommending that City Clerk Smith be instructed to advertise for bids to light the city for five years. The present contract with the People's Gas & Electric Light Company of this city will soon expire.

LEIPSIC, O.—At a recent meeting of the Council an ordinance granting W. W. Edwards and O. E. Townsend permission to operate an electric light plant was read, but no action was taken. The clerk, however, was instructed to advertise for sealed bids for the public lighting of Leipsic, with not less than 26 arc lights of 2200 cp.

BERKELEY, CAL.—The Berkeley Electric Light Company is about to purchase a lot and commence the erection of a station building. The stockholders have decided to bond the company for $30,000, which will be done at a meeting to be held April 20. The money will be spent in securing the new plant and in the purchase of new boilers, engines and dynamos.

CLEVELAND, O.—Hon. Milan Gallagher will present to the Cuyahoga delegation his bill to authorize the City of Cleveland to erect and operate electric light plants. The bill authorizes the city to expend $1,500,000 for this purpose, and to issue bonds to this amount. If the people approve, there will be three plants, one on the West Side, one on the East Side, east of Willson Avenue, and one west of that thoroughfare.

SUPERIOR, WIS.—The Altamonte Water Power Company, of Minnesota, the Minnesota Canal Company and the St. Louis Water Power Company, of Wisconsin, have come to an amicable agreement with respect to a comprehensive scheme for the development of water-powers on the St. Louis River. The proposition is to generate electricity at the falls by the St. Louis Company's power, and also to bring water to the head of the lake in large pipes, allowing it to fall over the top of the bluff at Duluth, thus generating more power, all of which is to be applied to the industries to the head of the lake.

THE ELECTRIC RAILWAY.

CHESTER, N. H.—The Chester & Derry electric railway is to be built in the Spring.

NIOBRARA, NEB.—A movement is in progress for the organization of a trolley system of railways out of Niobrara.

OSWEGO, N. Y.—The Oswego Street Railway Company has purchased the site of the old Shenandoah mill and will soon erect a power-house there.

NEW YORK CITY.—The Metropolitan Street Railway Company has decided, it is reported, to adopt the underground electric system on the Sixth and Eighth Avenue lines.

CHESTER, PA.—A charter has been granted the Chester & Marple Electric Railway Company, which will connect South Chester, Eddystone, Loiporville, Milmont, Swarthmore and Marple.

FULTON, N. Y.—The Fulton & Oswego Falls Street Railway Company will apply for a franchise, and ask for permission to build and operate an electric road in certain streets of the village.

TOPEKA, KAN.—The Topeka Electric Railway Company has prepared a petition which it will submit to the Potwin Council for a franchise to extend its line through Potwin and Auburndale to the asylum grounds.

ALBANY, N. Y.—A franchise has been granted authorizing the Albany, Greenbush & Bath Railway Company to build a road on the east side, the company being allowed one year to get the road in running order.

ST. PAUL, MINN.—Fire destroyed the old frame street car barns on University Avenue, between Mackuby and Kent Streets. There were nearly 100 cars of various patterns in the buildings destroyed. Loss, $75,000; partly insured.

HARRISBURG, PA.—The Centralia, Ashland & Locust Gap Railway Company, recently chartered, will build six miles of railway through the borough of Centralia to Conyngham Township. Electricity will be the motive power.

TONAWANDA, PA.—A new organization has been formed, under the name of the Bradford County Railway Company. The directors are C. A. Innes and John A. Innes, of Canton; Gen. J. A. Hill, of Powell; Robert B. Drake, of Monroeton, and John M. Rahm and Benj. T. Hale, of Tonawanda.

SIOUX CITY, IA.—In view of several street railway extensions contemplated across the river and also in this city, the Sioux City Traction Company is preparing to almost double the present capacity of its plant. In addition to the improvements, the entire rolling stock will be remodeled.

GENEVA, N. Y.—The Seneca County Railway Company, owned and managed by the Lehigh Valley, will have charge of the new railway to be built

from Geneva to Waterloo and Seneca Falls, on the south side of the Seneca River. Work on building the road will shortly be undertaken.

PORTLAND, ME.—At a special meeting of the City Council a petition was received from the Portland & Cape Elizabeth Railway Company asking for an additional location from Monument Square, across Congress Street, down Elm to Oxford Street, etc., to a point 20 feet from the southerly track of the Portland & Rochester Railway.

ELYRIA, O.—H. H. Clough, A. L. Garford, William G. Sharp and E. K. Mussey have been granted a franchise by the County Commissioners to build an electric line from Oberlin to Wellington. This will connect with the road from Elyria and Lorain at Oberlin. It is expected that the entire system will be built within the next 12 months.

NEW BEDFORD, MASS.—At a meeting of the directors of the Union Street Railway Company, a petition was presented asking that the electric line be extended down Union Street to the ferry landing. It was voted to ask the Board of Public Works for a location for the tracks. Work will probably be commenced as soon as permission is granted.

OSHKOSH, WIS.—A large mass meeting was held at the village of Omro to consider the proposition made by the Oshkosh capitalists for the construction of an electric road from this city to Omro. The capitalists interested are Leander Choate, William Dickmann, Thomas Wall, John Martin and Mayor Kellogg. It is the intention to construct about 11 miles of road.

CLEVELAND, O.—A project is on foot to connect Mansfield and Cleveland with an electric railway. At a recent meeting of Mansfield men, and Z. S. Stocking, of Cleveland, the Mansfield, Sullivan & Wellington Railway Company was organized. The proposition at present is to construct a passenger, mail and freight line from Mansfield northeast, through the villages of Ruggles and Sullivan, thence east to the villages of Penfield and Beldon, and north to Grafton or Wellington.

Trade and Industrial Notes.

THE MERRISON SOUTHERN ELECTRIC COMPANY, of Baltimore, Md., manufacturers of switches of all kinds, and of switchboards, is having a great run on its flush switch, which is claimed to be a very superior article, possessing many advantages over other types.

THE BAECHTOLD & PARKER ELECTRIC COMPANY, 70 and 71 Washington street, Brooklyn, has issued a new price list "A" of the American dynamo and lamp parts. All of the different parts are illustrated with a number attached referring to the ordering list, thus greatly facilitating telegraph orders.

THE NOWOTNY ELECTRIC COMPANY, Cincinnati, is meeting with much success in the sale of their new iron-clad type dynamos and motors. Among a few new installations made in Cincinnati are: One 250-light dynamo to the Hauser, Brenner & Fath Company; one 150-light dynamo to the Polar Bear Tobacco Works, and one 15-hp motor to the Ohio Glue Company.

RONTGEN TUBES.—Owing to the large demand recently made upon them for such apparatus, the New York & Ohio Company of Warren, O., makers of the Packard Incandescent Lamps, are now making a specialty of Crookes, Geissler and all kinds of special vacuum tubes for experimental work. They state that on account of their experience in and their special apparatus for the manufacture of their 500-cp Mogul lamps, they are exceptionally well equipped for this work.

THE NEW YORK EXHAUST & BLOW PIPE COMPANY, Hartford, Conn., have moved into their new factory, where they use the electric motor to run their machinery and elevator. Their line is manufacturing exhaust fans, dust separators, automatic boiler feeders, exhaust pipe heads and galvanized steel piping. They do an extensive business in equipping wood-working plants for the removal of dust and shavings, and feeding the same automatically to boilers. They also equip polishing and buffing rooms, for the removal of dust and lint. The New York office is at 136 Liberty Street.

CRANES.—In a large catalogue (from which we note with pleasure the absence of half-tone engravings) Alfred Box & Co., of Philadelphia, Pa., describe a large variety of hoisting apparatus, ranging from hand hoists to high-speed power traveling cranes. All the various types are illustrated by well-executed wood-cuts. Several of the more important types of power cranes are designed for operation by electrical power. The Box double screw hoists, we note, have been adopted by the United States government for use in all of the new ships of the navy. The final pages of the catalogue are devoted to a description of the well-known Box mechanical stoker and several forms of radial drills, including gang and post drills.

THE HOPPES MANUFACTURING COMPANY, Springfield, O., reports the following recent orders through its Western branch office, 515 Security Building, St. Louis, Mo., for feed-water purifiers and heaters: The St. Louis Dressed Beef Company, 750-hp purifier and 800-hp exhaust heater; the Christy Fire Clay Company, St. Louis, 400-hp purifier and 400-hp exhaust heater; the John E. Liggett Building, two purifiers of 100 hp each, and a 200-hp exhaust heater. The following St Louis concerns have also placed orders for various sizes of exhaust heaters: J. W. Peters & Co., 150 hp; the Laclede Laundry Company, 100 hp; the Globe Furniture Company, 150 hp; Leroi Furniture Company, 150 hp; the Central Lead Co., 300 hp; Liggett & Myers Co., 75-hp.

CHARLES E. GREGORY & CO., Chicago, Ill., are exceptionally busy for this time of the year, as may be seen from the following list of their recent shipments: One United States dynamo of 350 lights, two of 250 lights, one of 180 lights, and one of 140 lights; two Edison dynamos of 12 and 50 lights respectively, and two of 25 and 24 kw respectively; two Westinghouse motors of 15 hp, and one 60-kw Westinghouse alternator; one 2hp Eddy motor; one 2 hp-Bain motor; one 30-light Standard arc machine; one 2-hp Crocker-Wheeler motor; one 2 hp Detroit motor; one T.-H. motor of 2-hp, and another of 5 hp; two Sprague motors of 2 hp, and one of 3 hp; one 150-light Rockford dynamo; a 100-light transformer; a 110-volt exciter, and two 50-light dynamos.

MR. F. W. DARLINGTON, consulting electrician and mechanical engineer, Drexel Building, Philadelphia, has recently opened an office at Room 110, 111 Broadway, New York, in order to bring himself in close contact with his New York friends, and from which he is now in a position to handle engineering of the largest description, either equipping steam roads with electricity for passenger or freight service or for power or mining work. Mr. Darlington is now also making a specialty of electrical equipment for mines, for haulage or power. The Baldwin Locomotive Works are building the largest electrical mine locomotive ever built, on specifications made by Mr. Darlington. This locomotive is intended to draw a train load of 200 tons up heavy grades.

THE ELECTRICAL TRADES ASSOCIATION, of Philadelphia, is extending its field of operation. The object of the association is to give to the various members timely notice of such current purchasers of electrical apparatus and supplies as are becoming delinquent. The association is chartered and has acted under eminent legal advice. It is based on a similar association which has been in existence in the plumbing trade for several years very successfully. Realizing the benefit it has been to its members in Philadelphia, the Executive Committee is desirous of co-operation with New York, Boston, Chicago and other large centres, and Messrs. Charles E. Trump, of the Novelty Electric Company; C. M. Wilkins, of Partrick & Carter and Antoine Bournonville, of the firm of Alfred F. Moore, have been appointed a committee to confer with those interested in the movement in New York. These gentlemen will be at the Astor House, in New York, on Wednesday, March 4, to meet such as desire to establish a branch here. As mentioned in last week's ELECTRICAL WORLD, a New England branch of the association has been established in Boston.

THE WAGNER MANUFACTURING COMPANY, of St. Louis, Mo., several months ago found it necessary to enlarge its manufacturing facilities and is now installed in its new three-story factory, which covers a ground space of 45 by 70 feet. In front of this building it is proposed to erect another shop which will cover a lot of 125 by 75 feet and will be seven stories high when finished. For this purpose the stockholders at a meeting held on Jan. 17 unanimously voted to increase the capital stock from $100,000 to $250,000 and at the meeting of the Board of Directors held on Feb. 18, it was decided to begin the construction of the building at once. The additional floor space will admit of tripling the present output, and the company will then begin manufacturing more extensively the specialties whose high character has resulted in its present prosperity. Of late the factory has been working over-time and, in fact, during part of the Winter in two shifts, but even then some orders could not be accepted when coupled with short allowance for shipment. The Wagner Company believes with reason that it is now in an admirable position to greatly extend the scope of its business and in a short time will be in the field for this purpose.

H. E. COLLINS & COMPANY, Pittsburg, Pa., announce that Mr. Daniel Webster, for 15 years associated with the Babcock & Wilcox Company, has resigned his position with that firm, to take effect March 1, in order to accept a position with the manufacturers of the Cahall boiler. Mr. Webster, for the last twelve years has been the practical head of the manufacturing and construction department of the Babcock & Wilcox Company, and has made many strong friends among the large steam users and manufacturers throughout the United States. Although the Cahall boiler has demonstrated its superiority as a steam generator, still there are many cases where lack of head room or prejudice prevents the adopting of anything but a horizontal water-tube boiler. The Aultman & Taylor Machinery Company, of Mansfield, O., have therefore decided to immediately engage in the manufacture of water-tube boilers of the Babcock & Wilcox type, and Mr. Webster will have entire charge of this department. Aultman & Taylor expect to be ready to begin delivering the Babcock & Wilcox type of water-tube boiler by June 1. H. E. Collins & Co., of the Bank of Commerce Building, Pittsburg, Pa., general sales agents for the Cahall boiler, will act in the same capacity for the Babcock & Wilcox type.

THE DAVIS & EGAN MACHINE TOOL COMPANY.—Recognizing the rapid development of the iron industry of this country, Mr. Robert Laidlaw, president of the Laidlaw-Dunn-Gordon Company, together with Mr. Thos. P. Egan, president of the J. A. Fay & Egan Company, and Mr. Chas. Davis, president of the Lodge & Davis Machine Tool Company, all of Cincinnati, have purchased all the stock heretofore held by William Lodge in the Lodge & Davis Machine Tool Company, which will be reorganized at once, and the name changed to the Davis & Egan Machine Tool Company, Mr. Chas. Davis continuing president. The new company will control unlimited capital, and the plant, which now has 60,000 square feet of floor space, will be largely increased. New lines of heavy railway tools will be added, and the business promises to be one of the most extensive of the kind in the world. They manufacture tools for the production of locomotive and stationary engines, steam pumps, electric dynamos and motors, agricultural implements, sewing machines, bicycle machinery, wood-working machinery, mining machinery, etc. They have furnished the United States Government large numbers of machines for the manufacture of cannons, guns, etc., and are well represented in the navy yards at Washington, Norfolk, Water Vliet, Brooklyn, and Mare Island. They cultivate the export trade largely, and have made shipments to nearly every civilized country. They have regular authorized agents who travel in Mexico, South America, Russia, France and Germany. The company have of late entered largely into the manufacture of special bicycle machinery, and as a result are compelled to operate their works night and day to its full capacity. The company operate their own stores in New York, Chicago, Philadelphia, Boston and St. Louis. They have no outstanding bonds, preferred stock or indebtedness of any nature, and at a recent meeting of the board of directors they declared and paid a dividend of 6 per cent. for the last six months.

Business Notice.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED FEB. 25, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York]

555,068. ELECTRIC CAR LIGHTING APPARATUS; W. Biddle, Brooklyn, N. Y. App. filed Dec. 24, 1894. The combination with the field magnets and armature in a dynamo of a magnetic intercepter and means for moving the same endwise of the armature in proportion to the speed of the armature, to intercept the lines of magnetism as the speed of the armature is increased or the reverse.

555,073. SHORT DISTANCE TELEPHONE COMMUNICATION; W. L. Bradshaw, Cincinnati, O. App. filed Sept. 28, 1895. In a telephone system, a hook, in combination with a supporting ring provided with a shank extending through hole in receiver case and through spiral spring, and loosely fitting, but suitably held from turning, and rigidly attached to near the middle of a curved plate, contacts and wires adapted to furnish low resistance path either way from the hook.

555,074. ELECTRIC TRANSFORMER; W. Carter, Louisville, Ky. App. filed April 23, 1895. In an open iron circuit-transformer, the combination of a primary and a secondary coil, a series of contact plates to which the successive windings of the latter coil are connected, a stud carrying at one end a contact arm for traversing the said plates, and at the other end an insulated disc; a conductor to which one terminal of the primary is connected, a pin arranged adjacent to the said conductor and to which is connected the other terminal of the primary, and means on the disc for opening or closing the primary coil coincidently with the movement of the contact arm.

555,076. ELECTRICAL VISUAL INDICATOR; F. W. Cole and W. M. Chapman, of Newton and Needham, Mass. App. filed June 3, 1892. In an electric visual indicator several spring-actuated intermittingly and successively operating indicating surfaces, and an electromagnet controlling their intermittent operation combined with a single timing mechanism controlling their successive operation, the releasing or controlling lever of which is released or caused to operate by that indicating surface which operates in response to the first impulse received.

555,090. SECONDARY ELECTRIC CLOCK; F. L. Gregory, Chicago, Ill. App. filed May 11, 1895. The combination with a power wheel, and with an actuator, and with means for intermittently operating said actuator, of a reciprocally effective impulse-pawl and locking detent, the former of which is in normally unlocking engagement with the power wheel, and the latter of which is in normally locked engagement with said power wheel; and an oscillatory pawl locking and detent releasing device controlled by the actuator, and adapted for simultaneously actuating the pawl and detent to lock the former into engagement and unlock the latter from engagement with the power wheel upon the inauguration of the working stroke of the actuator.

555,101. ELECTRIC ANNUNCIATOR; J. Kips, Yonkers, N. Y. App. filed Jan. 8, 1895. The combination with a pivoted drop, a spring having a catch at its free extremity, an insulated stud taut-wire extended from said stud to the spring, a pivoted bar arranged to arrest by contact the descent of the drop, of a battery, the wire from one pole of which connects with the taut-wire, while that from its opposite pole connects with the drop to actuate a signal when the drop has come in contact with the bar.

555,112. HANGER FOR ARC LAMPS; A. J. Oehring, Chicago, Ill. App. filed Sept. 18, 1894. In a hanger board the combination with a contact arm, comprising parallel plates, one of said plates being provided with an inward projection, a contact terminal adapted, when said arm is closed, to rest between said plates to make contact therewith, said contact terminal being provided with a channel adapted to be engaged by said projection, and a spring for returning the contact arm to its opened position.

555,114. CIRCUIT CONTROLLING APPARATUS FOR SCENIC THEATRES; A. J. Oehring and A. L. Tucker, Chicago, Ill. App. filed May 13, 1895. The combination with an electric switch of a pivoted lever bifurcating at the lower end and connected at the upper end with a movable element of said switch, a continuously rotating shaft, a pair of arms mounted upon said shaft, one of said arms being adapted to engage one member of the bifurcated end of said lever to rotate said lever and close said switch, and the other arm being adapted to engage the other member to open said switch.

555,120. ELECTRIC ANNUNCIATOR; F. Porath, Appleton, Wis. App. filed July 6, 1895. The combination with a steam boiler of a disc secured to the end thereof and provided with a screw-threaded boss, and with a split sleeve having depending ears, a flanged nut having a screw-threaded socket to receive the boss, and provided with a screw-threaded tubular extension, a stuffing nut secured on said extension, a rod having a slot at one end, a float pivoted between said ears and provided with an upturned end to engage said slot and electric alarm, and a connection between said alarm and the sliding rod, whereby when said float rises or falls the electric circuit will be completed and the alarm sounded.

555,130. ELECTRIC WELDING INDICATOR; E. Thomson, Lynn, Mass. App. filed July 23, 1888. The combination with an electric transformer of a counter secured to the secondary bar or circuit of such transformer, and means for actuating or controlling such counter by the current flowing in the bar.

555,131. ELECTRIC RIVETING; E. Thomson, Swampscott, Mass. App. filed Oct. 22, 1890. The improvement in electric riveting consisting in placing a two-part rivet blank in position with the parts abutting within the pieces to be fastened together, passing an electric current through such abutting portions, and then subjecting the same to endwise pressure, so as to weld the two parts together to complete the rivet, and at the same time form a head or enlargement to give increased resistance against shearing strain.

555,136. ELECTRIC ELEVATOR CONTROLLER; E. P. Warner, Chicago, Ill. App. filed Oct. 29, 1892. In the actuating mechanism of a variable rheostat the combination with the cam of a connecting rod adapted to be moved in one direction by said cam and an adjustable dash pot adapted to regulate the rate of movement of said connecting rod in the other direction.

555,145. TROLLEY WHEEL SWITCH; P. A. Williams, Decatur, Ill. App. filed June 10, 1895. A switch for trolley wires comprising a plate having grooves in its under surface extending from one side of the main wire to the corresponding side of each switch, wire holes extending obliquely upward through the metal left between the grooves, recesses in the upper surfaces above the holes and clamp bars above the recesses.

555,152. CONSTANT POTENTIAL ALTERNATING GENERATOR; W. K. Freeman, Fort Wayne, Ind. App. filed July 5, 1895. The combination with a system of generator regulation embodying a pulsating current generator, a transformer having its primary in series with the working circuit of the generator, and a secondary controlling the energizing of the field of force of a current regulator controlled by the speed of rotation of the main drive shaft interposed in said secondary circuit of the transformer, whereby the energy of the field of force is governed in accordance with both the rate of rotation of the drive shaft and the consumption of energy in the working circuit.

555,154. TELEPHONE TRANSMITTER; A. Graham, London, England. App. filed May 3, 1894. In a telephone transmitter, the combination with a body of insulating material carrying the stationary electrode of a terminating knob and cover and a circuit controller composed of a plunger passing through said knob and a circuit closing spring with which the plunger engages.

555,160. ELECTRICAL CALL AND ALARM APPARATUS; J P. Hartfuss, Merzig, and E. Herz, Saarbruck, Germany. App. filed Feb. 14, 1895. The combination with a signal arm, means for raising the same, and a detent for retaining said arm when raised of a shaft carrying said arm, a sleeve on said shaft, pin in said sleeve, and contact spring located to be in contact with said pin when arm is raised, and out of contact therewith when said arm has fallen.

555,165. TELEGRAPH REPEATER; L. Horton, Jr., Reading, Pa. App. filed Dec. 14, 1895. The combination in an automatic repeating apparatus of two main circuits entering a signal station, two relays, one in each line at said station, a local circuit containing an electromagnetic spring contact, transmitting instrument operated by said relays respectively; an electromagnetic retractor for the armature of each relay, and an extra local circuit for each retractor, the extra local circuit of one relay-retractor including the down contact-stop, and movable or armature contact operated by the automatic transmitter controlled by the second relay, whereby a break in the second circuit, due to the operation of the first relay, occurs after a break in the retracting circuit of the second relay, and vice versa.

555,167. ELECTRIC RAILWAY SIGNAL SYSTEM; J. Irwin, Omaha, Neb. App. filed Feb. 18, 1895. An electric railway signal system, comprising a track having its rails at each station dividing into six insulated sections, of which two are grounded, a visual signal comprising two signal discs and four magnets operating them, a signal circuit wire between the stations, and a single battery at each station connected to the rail sections, the magnets, the line and the ground.

555,181. TOY; J. F. Prentice, Brooklyn, N. Y; App. filed July 24, 1895. In a toy, tank, filled or partially filled with water, in which are placed two figures, one of which is smaller than the other and adapted to enter the mouth thereof, the first of said figures being provided with a piece of metal, and a piece of magnetized metal being placed in the mouth of the latter and a stronger magnet being secured at the bottom of the vessel.

555,190. ALTERNATING MOTOR; Nikola Tesla, New York, N. Y. App. filed May 15, 1888. The combination in an electromagnetic motor, with an alternating coil or conductor, and a closed circuit conductor in inductive relation thereto, of an armature mounted so as to be within the field produced by the coil and closed conductor.

555,191. ELECTRIC MOTOR; E. Thomson, Swampscott, Mass. App. filed Dec. 19, 1890. The herein described method of compounding in electric motors, consisting in establishing two motor-poles or sets of poles polarized in a direction such that they will conspire to produce rotation at light load, and reversing the polarity of one upon increase of load beyond a predetermined amount.

555,192. ELECTRIC LIGHTING SYSTEM; S. L. Trippe, New York, N. Y. App. filed June 21, 1893. The combination with a dynamo or other source of electric current, and a plurality of circuits, of a transferring device for changing the current from one circuit to another, and a series of shunts for neutralizing the induced current by allowing a portion of the supply current to pass directly to the first mentioned circuits without being transformed by passing through the transferring device.

555,208. CONDUIT ELECTRIC RAILWAY; C. M. Bridges, Seattle, Wash. App. filed May 31, 1895. In a conduit electric railway and in combination with a series of rollers, in the conduit normally out of electrical connection with a supply conductor, a contact-bar carried by the car and adapted by contact with said rollers to throw them successively into electrical connection with the conductor, and a hanger from the car passing through the slot of the conduit and secured to the flexible bar, said hanger having the extremities of its arms fitted with oscillating pins to which the contact-bar is secured, whereby it effects the bending of said bar to conform to the direction of travel.

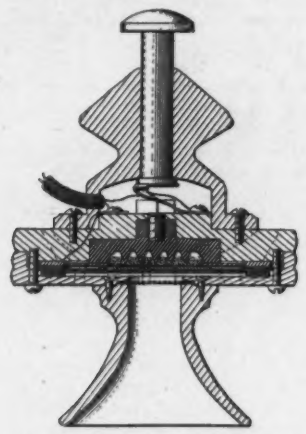
555,216. ARMATURE WINDING; W. H. Knight, Schenectady, N. Y. App. filed April 13, 1895. An armature coil for a dynamoelectric machine or a motor made in the shape of a six-sided figure, composed of two trapeziums having their common side missing, and lying in different but parallel planes, the two trapeziums united by portions of the coil approximately radial to the circumference of the core to which it is to be applied.

555,217. ELECTRIC SIGNALING DEVICE FOR RAILWAYS: G. A. Lyncker, Munich, Germany. App. filed April 27, 1895. In combination, an electric circuit, with signals at the terminal stations, the intermediate stations, having signals in series on one side of the line contacts at the stations, connections across the line at the stations including said contacts, whereby signals will be sent ahead of the train at each station and the signal in the rear will be cut out, the contact at the sending station and a supplemental circuit including a signal at the sending station and a contact at the first intermediate station.

555,222. RAILWAY TELEPHONE SYSTEM; W. H. Nixon, Providence, R. I. App. filed Jan. 28, 1895. A railway telephone system consisting of a metallic conductor, two telephones, one at each end of said conductor, means for completing the circuit between said telephones, a second metallic conductor normally electrically connected to the opposite pole of one of said telephones to that to which is connected the other metallic conductor, a switch normally closed to make the connection of the second metallic conductor and telephone, but capable of being opened and a series of pairs of branch wires from the metallic conductors, normally open, but capable of being electrically connected together by a portable telephone.

555,239. TELEPHONE; M. Garl, Akron, O. App. filed April 4, 1895. In a telephone, the combination of a helical L-shaped spring, having attached to the free horizontal portion of said spring a diaphragm, said diaphragm being free to vibrate with the spring, an electrode, and a receiver.

555,248. ELECTRIC RAILWAY; W. H. Jordan, Brooklyn, N. Y. App. filed Jan. 17, 1896. The combination with an electric railway of a divided signalling circuit, a switch at each end of the circuit, a connection from one switch to the working conductor, a connection from the other switch to earth, containing signalling devices and a means at each switch operated by the contact devices carried by the car for operating the switch, whereby the signalling devices are successively connected with each division of the signalling-circuit.



No. 555,154.—Telephone Transmitter.

555,252. ELECTRIC PROPULSION OF VESSELS; E. R. Le Sueur, Ottawa, Canada. App. filed March 26, 1894. The means for electric propulsion of a vessel, consisting of a conduit located beneath the surface of the water, a conductor in said conduit, insulated fluid of greater specific gravity than water within said conduit and a contact or collecting device electrically connecting said conductor with the current using device of the vessel.

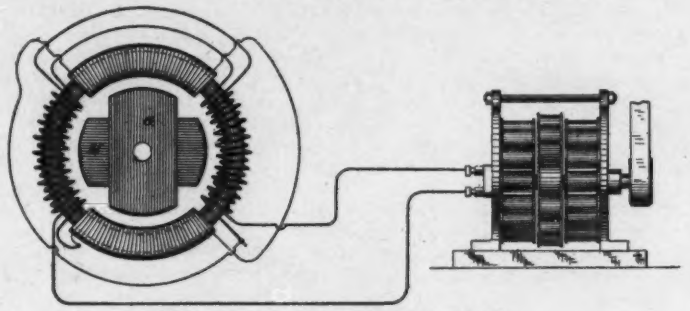
559,259. ELECTRIC HEATER; J. F. McElroy, Albany, N. Y. App. filed May 31, 1895. In an electric heater, the combination of a casing containing a resistance adapted to be heated by a current of electricity, a partition placed in the rear and upper portion of said casing, whereby an air space is formed between said partition and the back and top of said casing through which air can circulate, said casing containing air ports, permitting air to enter said air spaces at its lower portion and to emerge from said air space at its upper portion.

555,263. CONTACT DEVICE FOR ELECTRICALLY PROPELLED VEHICLES; E. B. W. Reichel, Gross-Lichterfelde, Germany. App. filed Aug. 15, 1895. The combination with a horizontally extending frictional contact device, and a central revoluble contact.

555,266. UNDERGROUND CONDUCTOR SYSTEM FOR ELECTRIC RAILWAYS; C. T. H. Schwieger, Berlin, Germany. App. filed Nov. 15, 1895. In an underground conductor system for electric railways, the combination with a series of contact terminals adapted to normally rest in a depressed position of an operating rod or part, the end of which normally projects into the path of a wheel or other part of the vehicle, mechanism between the contact terminals and the rods for raising the contact terminals when the rods are depressed, a rod or part provided in connection with each contact-terminal adapted to occupy an elevated position when the contact-terminal is raised and a wheel or other part carried on the vehicle adapted to engage and depress said rod to return the contact terminal to its normal position.

555,286. ELECTRICAL MEASURING INSTRUMENT; F. Von Hefner-Alteneck and H. Gorges, Berlin, Germany. App. filed Nov. 25, 1895. In an instrument for measuring the strength of an electric current the combination with a solenoid adapted to be traversed by said current of two rods of iron of such thickness that they will magnetize to saturation by the weakest current to be measured, said rods being as near disposed as possible to the coils of the solenoid, a balance upon one end of which said rods are hung, the other end of the balance being suitably weighed, and means for indicating the position of the balance.

555,291. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; E. A. Sperry, Cleveland, O. App. filed Feb. 16, 1895. In a shunting switch for a motor the combination with a manually-actuated contact, a resistance included in circuit with said contact, an additional resistance shunting the aforesaid resistance, and an electromagnetically-operated contact.



No. 555,190.—Alternating Motor.

555,301. REGULATING ELECTRIC DISTRIBUTION SYSTEM; J. Burke, Schenectady, N. Y. App. filed Dec. 24, 1894. The method of regulating the potential in an electric circuit, which consists in supplying the circuit with a current from main sources of supply of different potential and regulating the potential of the supply current by intermediate variable sources of electromotive force which act inversely upon the main sources of supply to reduce the potential of the one, and raise the potential of the other.

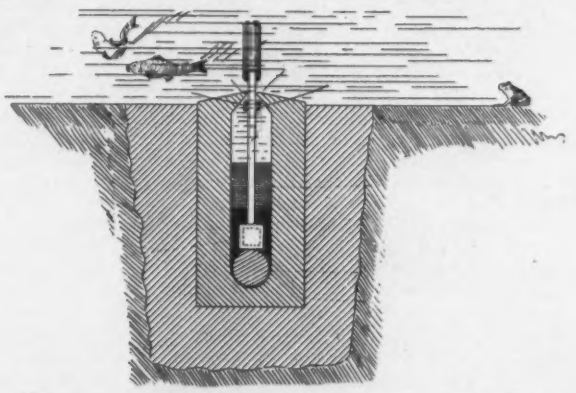
555,303. PRIMARY BATTERY; W. A. Crowdus, Chicago, Ill. App. filed June 12, 1895. In a primary battery, a metallic conducting support adapted to be secured to and form a part of the battery partition, provided with a spring pocket for holding the negative element in position and permitting its free insertion or removal.

555,304. PRIMARY BATTERY; W. A. Crowdus. Chicago, Ill. App. filed Oct. 4, 1895. A negative element for primary batteries, consisting of a reticuled supporting conducting plate, provided with a porous coating of baked copper oxide and a carbonized binder.

555,305. ELECTRIC LAMP FOR VEHICLES; W. A. Crowdus, Chicago, Ill. App. filed Oct. 4, 1895. In an electric vehicle lamp, the combination of a battery cell provided with a metallic supporting piece, a lamp having a metallic back portion, one of such portions provided with a projecting hinge, and the other with a hinging perforation, and means for positioning and locking the lamp in its supporting piece.

555,313. ELECTRIC CLOCK; Sigismund Fischer, Brooklyn, N. Y. App. filed May 10, 1895. The combination with a swinging pendulum and its crutch of a recessed block on said crutch, a fulcrumed circuit-closing lever, a gravity pendent pivoted to one end of said lever adjacent to said block, and a circuit closing device operated by the opposite end of the circuit-closing lever when the pendent is engaged by the recessed block.

555,320. HANGER FOR SIGNAL LANTERNS; E. R. Knowles, Middletown, Conn. App. filed Dec. 5, 1893. A hanger for signal lanterns composed of two parallel ropes, turn buckles connecting the lower ends of said ropes to separate fixed supports, a yoke secured to the upper ends of said ropes, and a series of scotchmen secured to said ropes, each scotchman having a T-head at each end, and an eye at the middle in combination with a series of lanterns containing electric lights, each lantern having a bail at the upper end for hanging it to the eye in the scotchman and a chain or other adjustable connection at the lower end running to the eye in an adjacent lower scotchman, and a cable containing insulated electric conductors fastened to one of the hanger ropes, said conductors being successively led out to the lanterns between the scotchmen supporting the same.



No. 555,252.—Electrical Propulsion of Vessels.

555,326. ELECTRIC DISTRIBUTION SYSTEM; E. C. Myrick, Providence, R. I. App. filed May 23, 1893. The combination with an electric circuit containing one or more lamps or other translating devices, and a fuse box of a shunt circuit extending around said fuse box, an annunciator arranged to be operated by the passage of a current through said shunt circuit, and means for breaking the shunt circuit when said annunciator has been operated.